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A PRACTICAL JOURNAL BUILT ON MERIT

EDITORIAL

THE SURGERY OF THE LARGE BOWEL

IN 1879 Schede resected a tumor of the colon and, being unable to make an anastomosis, performed a double barrelled colostomy. In 1885 Kraske presented his sacral operation for malignancy of the rectum before the fourteenth Congress of German Surgeons, and in 1892 Block of Copenhagen was the first to perform exteriorization of the colon without resection of the growth. In the same year Paul of Liverpool extended the principle of exteriorization with resection, a procedure later to be popularized and associated with the name of Mikulicz (1902). These contributions stimulated the study and progressive development of the principles of colonic surgery.

Malignancy of the large intestine occurs about as frequently as malignancy of the stomach and fully 75 per cent of all organic diseases of the colon are malignant. In spite of the frequency of malignancy of the large bowel and contrary to the general hopefulness of surgical intervention, we are aware of a general professional apathy; a sense of defeatism in the minds of general practitioners and among many of the internists. The general practitioner will ordinarily be the first doctor to make a diagnosis or at least be suspicious of the presence of a bowel malignancy. The diagnosis of neoplasm of the large intestine can be made with great precision and relatively inexpensively. The procedures for an accurate diagnosis are not many or detailed, nor do they involve extensive laboratory studies. All that is required is a searching inquiry into the bowel habits of the individual, a complete physical examination including proctoscopy or sigmoidoscopy, and the utilization of the roentgenologist. In few fields of surgical diagnosis are the means for diagnosis so readily available and so easily applied and carried out.

The establishment of colon clinics in our general hospitals, the increase in postgraduate instruction, and the education of the laity have developed to a slight degree a so-called "colon-consciousness," and yet fully two-thirds of the patients who come to surgery have had their neoplasm for a considerable period of time. Rankin states the significant statistical fact that about as many patients with carcinoma of the right half of the colon are operated upon for chronic appendicitis and chronic cholecystitis as patients with carcinoma of the rectum are operated upon for hemorrhoids. On the other hand, the surgical observer is rather surprised with the rarity of exploratory laparotomy for disease of the colon.

The advances that are to be made in the cure of patients with malignancy of the large bowel will depend upon an increase in the percentage of operability. When only 20 per cent of the individuals seeking surgical relief for malignancy of the colon are considered reasonably operable cases

there are obvious deficiencies in early diagnosis in that community. When one contrasts this with an operability of 50, 60 or even 65 per cent in some of the best equipped colon clincs we may be sure that after the five year interval there may be an increase in hospital mortality but there will be considerably more persons alive and well than when the low percentage of operability obtains.

Of great importance in the consideration of malignancies of the rectum is that the psychology of a patient with this disease is markedly different from that of the individual with a carcinoma of the stomach. The man who has had a radical resection for carcinoma of the stomach is not at all times reminded of his malady and if recurrence occurs he has no disturbing discharge of stool from a colostomy. Contrast the terror that is present in the mind of an individual who has survived radical abdominoperineal resection of the rectum and has a permanent colostomy. How often do we hear the expression "I would rather be dead than have a permanent colostomy" and yet a permanent colostomy is not incompatible with a life of activity and well being. The mental distress of losing the normal mechanism for bowel evacuation is in many patients at present insurmountable, and until the profession generally changes their viewpoint—erroneous to be sure—in regard to permanent colostomies, the physician cannot expect to carry to the patient a high degree of optimism.

It is the hope of the Guest Editor that the field of surgery of the large bowel and rectum has been adequately covered in this Symposium. There will be overlapping by the various authors and this has been desired. Opinions will perhaps differ in regard to some of the technical details yet the philosophy underlying this subject and its rationalization will be apparent as a continuous story that runs through all of the contributions.

The various authors are unusually qualified in experience and technical ability. The subject of malignancy of the large bowel occupies first place in the symposium. Neoplasms are considered generally and regionally. Consideration is given to the many and diverse factors that attend localization and metastases. Variations in the application of technical procedures to the disease and the patient are discussed and the reasons given for the modification of classical operations by reason of the localization of the tumor. Decompression operations are an integral part of the technical subject and ordinarily are not included in our textbooks. The problem of one-stage or two-stage operations, the anterior and posterior approaches, the mortality and morbidity factors, the various postoperative complications, together with recent additions to our knowledge of chemical and water balance, occupy a prominent place in this Symposium.

Discussions of the incidence and treatment of diverticulitis, polyposis, gunshot wounds and colon trauma, cicatrizing obstructing inflammation of the bowel, chronic ulcerative colitis, and instrumental diagnostic aids plus roentgenology make for completeness.

It would appear that surgery of the large bowel is beginning to occupy its true place in modern surgery and it is our earnest hope that the sense of terror that has heretofore prevailed in the minds of some practitioners, no less than in those of the patients, is in the course of being dispelled.

The Guest Editor desires to express his personal appreciation and thanks to all the contributors to this Symposium.

Charles Gordon Heyd, M.D., F.A.C.S.

ORIGINAL ARTICLES

NEOPLASMS OF THE CECUM AND ASCENDING COLON*

FRANK H. LAHEY, M.D.

BOSTON, MASSACHUSETTS

ONE of the reasons that the end results of radical removal of segments of the colon for carcinoma of that structure are so good (42 per cent of the patients are alive and well without recurrence over five years, in our hands) is due to the fact that 75 per cent of the malignancies of the large bowel occurred in the descending colon, sigmoid, rectosigmoid and rectum. The good results are related considerably to the fact that lesions as close to the anus as those located in these segments are, tend to produce early attention—attracting symptoms so that diagnoses are made in time to obtain good end results.

In carcinomas of the sigmoid and rectum occurring in our experience (we have now operated upon over a thousand patients with carcinoma of the colon and rectum) in 80 per cent of the cases with lesions located at these levels the lesion was palpable either through the abdomen or by rectum. When also one realizes that the feces at this level are solid and thus tend to produce early obstructive lesions and, in ulcerating lesions, bleeding, it is likewise obvious why these lesions give early evidence of their presence.

Dr. Swinton, who is in charge of the proctological department in the Lahey Clinic, has analyzed the histories in 100 proved cancers of the right colon, 100 proved cancers of the left colon and 100 proved cancers of the rectum and found that of the entire group, there was an alteration in bowel function or abdominal cramps or pain or abnormal stools in 97.7 per cent of the cases. When we analyze these figures, as shown in Table 1, however, it is to be noted that in the rectum 86 per cent had abnormal stools, in the left colon 46 per cent had abnormal stools, but in the right colon but 9 per cent had abnormal stools.

TABLE 1
SYMPTOMS OF CARCINOMA OF THE COLON AND RECTUM (300 CASES)

	Rectum, Per Cent	Left Colon, Per Cent	Right Colon, Per Cent	Total, Per Cent
Blood in stool	86	46	9	46
Altered bowel function	79	82	81	80
Abdominal cramps or pain	7	77	86	47
None	2	2	3	2.3

In lesions of the right colon, therefore, the feature in the history of abnormality in the stools which is so often present in malignant lesions of the left colon and rectum, is lost.

We have often stated that the physiologic function of the right colon plays a considerable part in the symptomatology of lesions in the cecum and ascending colon and likewise has much to do with the mortality of operative procedures in this region.

Due to the fact that the contents of the right colon are liquid in character, due to the fact that the liquid contents of the right colon are rich in highly virulent

* From the Department of Surgery, the Lahey Clinic, Boston, Massachusetts.

organisms, operative procedures such as direct anastomosis when associated with any contamination are particularly apt to result in peritonitis.

Likewise, due to the fact that the contents of the right colon are liquid in character, rarely does one see obstructive symptoms in malignancies at this level until the lesions are so well advanced that they completely or almost completely encircle the caliber of the colon and are thus often in late and inoperable stages. The only exception to the appearance of obstructive symptoms early in lesions of the right colon is when the malignancy of the cecum is close to the ileocecal valve and involves that structure. Relatively early, and relatively small lesions in this location can produce obstructive symptoms even up to complete obstruction.

The outstanding clinical feature by which early diagnosis may often be made in lesions of the cecum and ascending colon is secondary anemia. Why secondary anemias should be so consistently associated with malignancies of the cecum and ascending colon has never been adequately explained. It has been suggested by many that absorption of the noxious toxins from the highly virulent organisms in the warm moist culture media of the liquid feces of the right colon through the ulcerating base of the malignant lesion may well explain this secondary grade of anemia. While this is possible, it hardly seems an adequate explanation of the severe grades of anemia, giving the patient the typical lemon yellow color of intense secondary anemias that occur with these diseases. It has often been possible for me to make the diagnosis of probable carcinoma of the right colon merely from the color of the patient and from his statement before examination that he has vague pains in the right side of the abdomen. I know of no malignant lesion where such severe blood changes can appear and produce such changes in the facial appearance of the patient as with secondary anemia associated with lesions of the ascending colon. Certainly it is true that there appears to be no parallel situation in malignancy where such severe grades of secondary anemia can be present with the lesion still readily operable and the patient within a stage where radical removal can result in non-recurrence. Should such severe grades of secondary anemia be found associated with malignant lesions elsewhere, they would in practically all instances indicate metastases and non-operability of the lesion. One should bear in mind in dealing with lesions of the proximal colon that this exception as relates to the anemia exists.

It is unfortunate that one does not see in lesions of the cecum and ascending colon bright blood in the stools. Should bleeding occur it becomes so intimately mixed with the liquid fecal contents of the colon at this level that it is recognized only by studies for occult blood. Studies for occult blood, however, will rarely fail to show positive findings in the presence of malignant lesions of the right colon. In patients suspected of having malignant lesions of the colon anywhere it will always be wise to make careful studies for occult blood because rarely will malignant lesions of the colon at any level exist in the absence of occult blood in the stools.

X-ray findings in malignant lesions of the cecum and ascending colon are particularly apt to be confusing. Due to the fact that the cecum and ascending colon often have long mesenteries and are often redundant, when these structures are filled with barium the defects in the outline of early malignant lesions can be so located on the posterior wall that they are overshadowed by the distended overlying redundant cecum and ascending colon and easily overlooked.

It will frequently be necessary, from our experience, to repeat barium enemas in patients suspected of having lesions of the cecum and ascending colon and in addition to that, it will be necessary at times to send these patients home for a period of four to five weeks and to have them return for repeat enemas to check with the

original film. Exclusive of malignant lesions at the level of the rectosigmoid I know of no place in the whole colon where it is easier, particularly in early lesions, to overlook malignancies. It is unfortunate also that palpation of lesions in the right colon is frequently not positive until they are of considerable size and fairly advanced in character. It is easier as a rule to palpate lesions in the cecum and ascending colon than in the hepatic flexure where they are so often located deep under the outflaring arches of the ribs at this level.

One should have in mind always in the presence of an unexplained secondary anemia, particularly in any patient within the cancer age, the possibility of a malignant lesion of the ascending colon with little or no symptomatology associated with it. More than once in my own experience, failure to pay sufficient attention to an unexplained secondary anemia in the presence of other lesions has caused me to fail to diagnose a lesion of the cecum or ascending colon preoperatively only to find it to my chagrin and surprise during an operative procedure for another condition.

Frequently the only symptoms in patients with malignancies in the cecum and ascending colon are quite vague pain and feelings of bowel discomfort in the right quadrant. It has already been stated that when obstructive symptoms are present in lesions of the cecum and ascending colon one may be quite certain that the lesion is late. There is a quite dependable maxim associated with lesions of the large intestinal tract anywhere. There seems little question that the majority of the malignancies of the large intestine in the rectum, sigmoid, left colon and right colon originate in lesions which are primarily benign in character, that is, polyps and adenomas. Most surgeons who have had much experience and who are seriously interested in these disturbances are convinced of the association between polyps and carcinomas of the large intestine. It is for this reason that one may roughly assume that when a carcinoma of the large bowel at operation or *x*-ray examination has been found completely encircling the lumen of the bowel, its age is usually between six months and a year. This is due to the fact that a lateral wall lesion requires from six months to a year to encircle the bowel wall completely.

Since the treatment of malignant lesions of the cecum and ascending colon is universally accepted as surgical the only discussion necessary is regarding the type of surgery to be applied.

One may remove the right colon by a variety of procedures. Preliminary anastomoses between the transverse colon and the ileum may be established and at the end of two weeks the entire right colon may be removed.

The entire right colon may be removed at one stage and at this same operation the ileum implanted into the transverse colon.

The entire right colon with several inches of the terminal ileum and the hepatic flexure may be removed in one block together with its mesentery, the ileum may be approximated to the transverse colon, tacked to the transverse colon by the Mikulicz plan and the ends implanted in the wound. This is the procedure which we have now employed for several years and the one which we think offers the greatest degree of safety to the patient, particularly as relates to the danger of peritonitis.

We by no means wish to state that either of the two other mentioned procedures may not be employed. I can only state the reason why I devised this modification of the Mikulicz plan to apply to malignant lesions of the right colon and our experiences with it.

We feel very strongly that because we have so many right colons to resect we do not wish to worry about the danger of leakage and peritoneal contamination with any type of primary intestinal anastomosis. While we have had a large experience with intestinal suture we do not have confidence in our ability to make intestinal anastomoses with such certainty that they can be dropped back into the abdomen with

the same lack of worry on our part as to the danger of leakage and peritonitis as in the modified Mikulicz procedure here

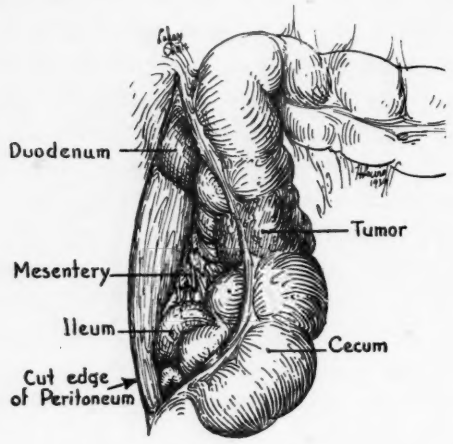

FIG. 1.

described. We do not mean to say that perhaps others cannot do primary anastomoses and intestinal sutures which leave them comfortable and unworried postoperatively. After having employed this modified Mikulicz type of procedure published by the author in 1932[1] we would not consider the employment of primary intestinal anastomoses if for no other reason than the confidence and peace of mind associated with the lack of danger of leakage and peritonitis with the modified Mikulicz plan of excision. We feel strongly that the large intestine with its often scanty blood supply, with its sacculated walls, its longitudinal bands and its epiploic appendages, with its highly virulent fecal content, lends itself most unfavorably to safe and dependable intestinal suture. We have therefore without reservation for several years assumed the position that when we resect the right colon it will be for practical purposes always by the modified Mikulicz plan here described.

This will necessitate approximately two months of discomfort on the patient's part while the fecal stream is at least in part discharged through the temporary colostomy opening. We feel that this, however, is but little handicap to the patient during this time and one well worth accepting when by it the danger of possible leakage and peritoneal contamination can be largely eliminated.

What type of operation one employs is governed frequently by a variety of factors, such as: how bad risks does one accept; how confident does one feel of his ability to do safe intestinal anastomoses; and how much colon surgery has one done. These factors lead different individuals to employ different methods. It is impossible for any single individual to insist that the procedure which he employs is the one for everyone. We therefore describe here the method which we have consistently adhered to, not because we think that other methods cannot be employed, but because our own experience proves to us that other methods cannot be employed *by us* as satisfactorily or as safely as can this procedure.

Resection of the right colon is first undertaken by making a long, right rectus incision extending from the tip of the cecum to above the level of the hepatic flexure. The lesion is visualized, the right colon is picked up by the assistant with two pieces of gauze and pulled toward the midline, the wound edge being retracted outward in the opposite direction by the other assistant. The external parietal peritoneum attached to the outer border of the ascending colon is then incised as was advised by William J. Mayo, carrying this incision well around the hepatic flexure to the transverse colon. (Fig. 1.) This procedure completely mobilizes the colon and it may be so wiped inward that it is now hanging by its mesentery. As it is wiped inward the first structures coming into view in the male patient are the spermatic vessels and in the female, the ovarian vessels. Next, one comes to the retroperitoneal ureter which in the right lower quadrant is adherent to the peritoneum and must be wiped off from that structure. As one dissects the ascending colon toward the middle line at its upper point the retro-

[1] LAHEY, F. H. Resection of the right colon and anastomosis of the ileum to the transverse colon after the Mikulicz plan. *Surg., Gynec. & Obst.*, 54: 923–929 (June) 1932.

peritoneal duodenum comes into view and must be separated from the mesentery of the upper part of the ascending colon. (Fig. 2.)

Care must be taken in separating the retroperitoneal duodenum (1) lest the duodenum be injured and (2) lest undesirable rents in the mesentery be produced. When the entire mesentery is wiped toward the middle line, when the spermatic vessels have been wiped down together with the ureter and the retroperitoneal duodenum has been wiped off the root of the mesentery, the mesentery of the ileum is then exposed and ligated down to its root, carrying, as shown in Figure 3A, this ligation along the root of the mesentery of the ascending colon up to the point where the transection of the colon at the transverse colon is to take place.

Care should be taken to leave a small apron of mesentery at its root over the mesenteric vessels, the aorta and the vena cava to protect these structures. (Fig. 3A.)

which I employed in my original description of this plan. This will provide a spigot of devascularized ileum sticking out beyond

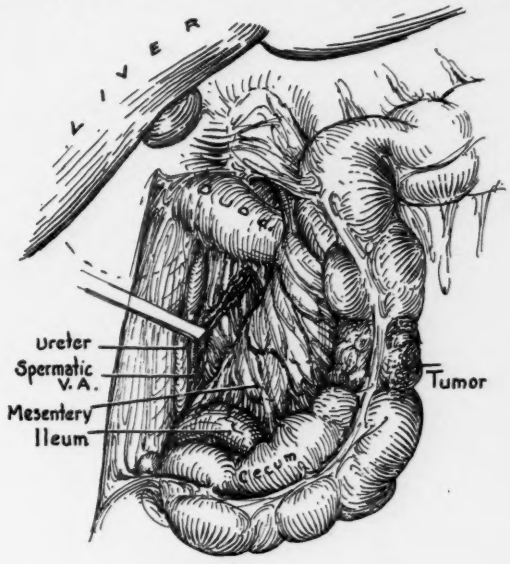

Fig. 2.

the abdominal wall, into which a glass tube may immediately be inserted after the operation. This secures immediate decompression of the intestinal tract as soon as the operation is completed.

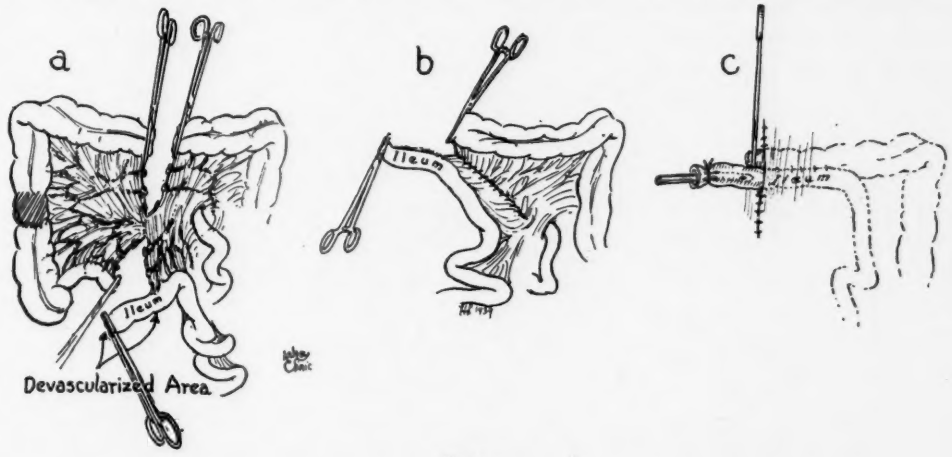

Fig. 3.

This small apron of peritoneum at the root of the mesentery likewise will provide a flap to suture to the apex of the triangle of mesentery removed with the ascending colon and hepatic flexure.

When the mesentery of the ileum is ligated, as shown in Figure 3A, about 4 inches of ileum is detached from its mesentery so that it is completely devascularized. This represents the portion of ileum which is to be staggered, the term

When the mesentery of the ileum and of the ascending colon and hepatic flexure has been completely ligated, two Ochsner clamps are placed on the ileum at the point where it is to be transected, and two more upon the transverse colon at the point where it is to be transected. The bowel between these two clamps is burned through with the actual cautery while the

surrounding structures are protected with drapes. The ends are thoroughly sterilized by means of the cautery. The segment of

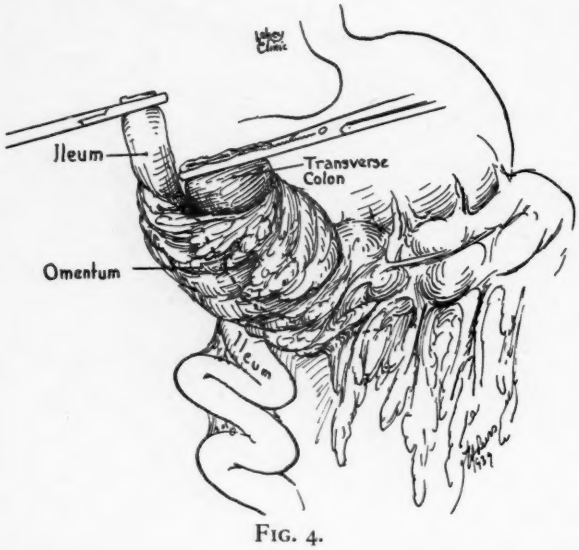

FIG. 4.

ascending colon and hepatic flexure containing the malignancy is now given to the pathologist and the preparation of the bowel for the modified Mikulicz procedure is undertaken. The ileum is placed beside the transverse colon, the rent in the mesentery made by the removal of the "V" of mesentery attached to the ascending colon and hepatic flexure is repaired (Fig. 3B), and a single row of tacking stitches of catgut is placed between the antemesenteric border of the ileum and the longitudinal band of the transverse colon. (Fig. 3C.) This double barreled Mikulicz approximation is tacked together for a distance of at least 6 or 7 inches.

One of the things that we have learned in doing so many modified Mikulicz procedures of all types is that one can make the Mikulicz spur too short, but one cannot make it too long. We have also learned that while one may adequately cut the Mikulicz spur down with clamps while the patient is in the hospital at the first stage, when he returns for the second stage, due to swelling and cicatrization, the septum may have so shortened up that it will require further cutting. It is for this reason that it is desirable to have a long approximation between the ileum and the transverse colon when the first operation is done.

With the ileum attached to the transverse colon, the remaining apron of omentum is now wrapped about the double barreled ileum and transverse colon, as shown in Figure 4, and the two loops of intestine implanted in the wound, the wound being closed snugly about the double barreled tube of intestine. No sutures are placed between the lumen of the bowel and the parietal peritoneum.

With the implantation of the double barreled loop within the sutured wound the first stage of the operation is completed and there remains only the necessity to drape the wound, to remove the clamp on the ileum which is serving as a spigot and to introduce a glass tube with a piece of rubber tubing connected to it which is carried to a bottle beside the bed, thus immediately accomplishing decompression of the intestinal tract. (Fig. 3C.)

At the end of four or five days the excess of nonvascularized staggered loop of ileum which has served as a spigot will slough off, so that the two ends of the Mikulicz, the colon and ileum, will then be at the same level within the wound. At this time an Ochsner clamp is introduced with one jaw in the colon and the other in the ileum and locked. (Fig. 5.) It is usually necessary to take approximately two bites with this clamp before a sufficient amount of the spur has been cut down. As soon as the spur has been severed some of the feces pass by rectum but a considerable amount still passes out through the colostomy made up of the now combined ileum and transverse colon.

These patients, as soon as the wound is healed, are sent home for a period of two months. We have tried reoperating upon these patients to close the temporary colostomy extraperitoneally earlier than this but this has proved undesirable. It requires two months for the peritoneum to become firmly attached to the Mikulicz intestinal loop and it requires two months for most of the edema to leave the wound

so that the bowel can be safely inverted in it.

At the end of two months the patients return in excellent condition, and under gas or spinal anesthesia an incision is made in the skin about the colostomy opening. (Fig. 6A.) This incision is carried down to the fascia. If the patient is thin the fascia and muscle are also separated from the wall of the bowel forming the colostomy. If the patient has a thick layer of fat we have found that it is not necessary to separate the tube of bowel from the fascia but this tube can be turned in and inverted down to the level of the fascia, and the fat closed over this. The end results prove to be quite as satisfactory as when the inverted end of bowel is buried beneath muscle and fascia.

We have now closed a great many of these secondary colostomies associated with these modified Mikulicz procedures and in none have we failed to accomplish complete closure.

Many visitors coming to the Clinic have complained that they have been able to close these temporary colostomies associated with the Mikulicz procedure with catgut but that at the end of ten days to two weeks fecal leakage occurred, with external drainage.

We believe that the success of secondary closure of the colostomies associated with these Mikulicz procedures is related to how thoroughly one denudes the wall of the temporary colostomy of its indurated fat and how thoroughly one severs any indurated mesenteric attachment to the colon. If one attempts to invert the tube of colon, as shown in Figure 7B, while indurated tabs of epiploic appendages or indurated segments of fat are attached to the wall, inversion can be accomplished with catgut, but only under tension; as soon as the catgut is absorbed eversion

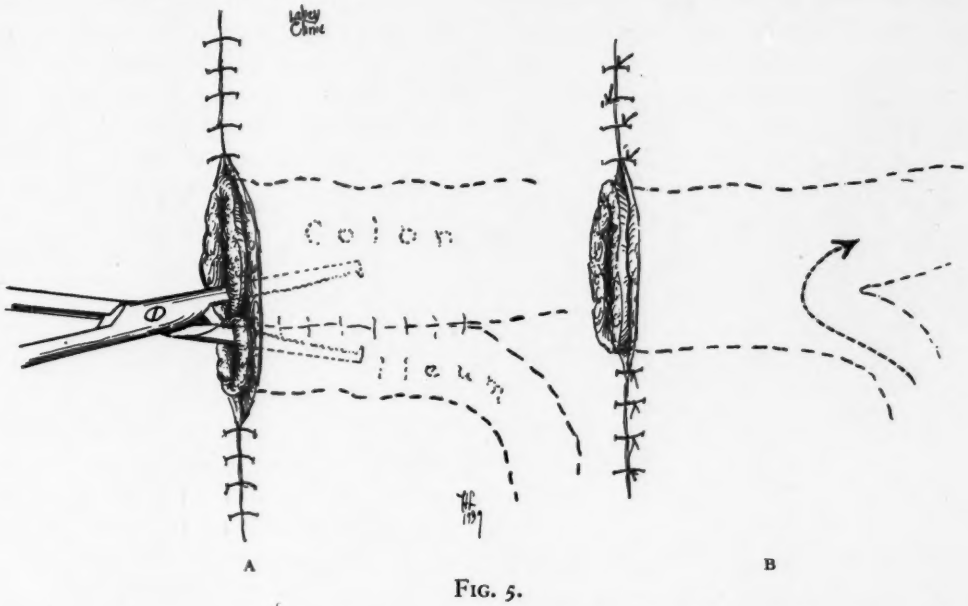

Fig. 5.

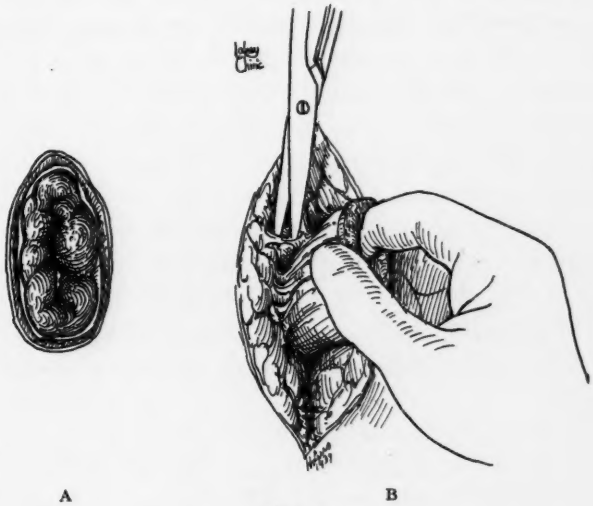

Fig. 6.

and pouting of the intestinal mucosa will occur and result in an intestinal fistula. It is only when the intestinal tube has been so thoroughly freed of its indurated fat that it is as flexible as normal intraperitoneal bowel, that complete, satisfactory and accurate inversion suture can be accomplished.

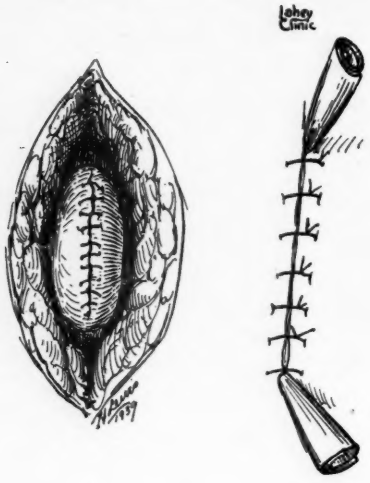

Fig. 7.

It was not until we learned thoroughly to free the tube of bowel, to drape the wound with gauze about the bowel and to insert a finger within the fecal contaminated lumen of the bowel so that we could use this as a guide upon which to excise the indurated tabs of fat that we satisfactorily accomplished inversion with uniformity. This is the only method by which we feel that it is possible to free this tube of bowel of its fat so that it can be inverted with satisfaction and with security. (Fig. 6B.)

The in-out-and-over suture devised by Connell is employed to invert the flexible wall of bowel thoroughly. (Fig. 7A.) An additional row of mattress sutures is then employed to invert the bowel further. If the patient is thin, as already has been stated, fascia and also muscle are sutured over the inverted bowel. A small segment of rubber dam is placed at the upper and lower ends of the wound. If the patient is fat, the inverted bowel is placed only below the level of skin and fat, no attempt being made to suture fascia over it. (Fig. 7B.) We have had no misfortunes with serious infections in these secondary closures.

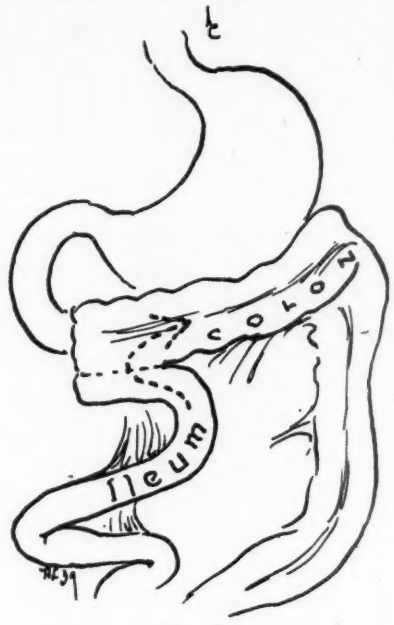

Fig. 8.

We believe as a result of a large experience with resections of all levels of the colon by the modified Mikulicz plan of procedure that one can safely say that this plan in no way limits the radicalness of the operation. At least in our hands it eliminates all fear and danger of peritoneal contamination and fatalities as the result. It permits complete and satisfactory restoration of the fecal stream without the production of obstruction or even constipation; Figure 8 shows the fecal stream after a Mikulicz resection. It has now been employed in this Clinic a sufficient number of times so that these points have been established to everyone's satisfaction.

CONCLUSIONS

The symptomatology of carcinoma of the cecum and ascending colon unfortunately is much more vague than in the left colon.

Fortunately but 16 per cent of the carcinomas of the colon occur in the cecum, ascending colon and hepatic flexure.

Unexplained secondary anemia should make one extremely suspicious of the presence of a possible carcinoma of the cecum or ascending colon.

X-ray diagnosis of carcinoma of the cecum and ascending colon is surrounded by pitfalls. Should there be any doubt, the *x*-ray examination should be repeated in a period of four to five weeks and even once again at the end of a similar period.

The modified Mikulicz plan of procedure has been employed in this Clinic almost without exception for a number of years and has given gratifying satisfaction.

Illustrations and the technical description of this operative procedure are submitted.

It can be fairly stated that bleeding from the bowel is the most important single symptom pointing to organic disease of the intestinal tract. . . . It is an indication of a break in the mucosa of the bowel somewhere along its course, or in the epithelium of the anal canal.

SURGICAL REMOVAL OF LESIONS OCCURRING IN THE SIGMOID AND RECTOSIGMOID

CLAUDE F. DIXON, M.D.

Division of Surgery, The Mayo Clinic

ROCHESTER, MINNESOTA

THERE is little controversy concerning the resection of the upper segment of the sigmoid which is sufficiently mobile to permit of exteriorization. The field of controversy concerns that portion of the pelvic colon which extends from the midsigmoid through the rectosigmoid. If conditions permit the involved portion of the intestine to be exteriorized I prefer to carry out an obstructive type of resection over a three-bladed clamp in preference to utilizing the Mikulicz method. Should the lesion be situated in that portion of the pelvic colon which cannot be exteriorized, I elect, if possible, to carry out a type of operation which leaves the sphincteric mechanism intact but nevertheless removes the malignant lesion in a radical manner.

The Mikulicz type of exteriorization has been employed with satisfactory results in many instances, but it is important to keep in mind that the true Mikulicz operation is not sufficiently radical to remove involved mesenteric lymph nodes. In cases in which it is employed the affected segment is exteriorized and covered by vaseline gauze; removal of the segment is effected several days later. When study was made of a large series of cases observed at the Mayo Clinic it was found that recurrence of the malignant process had developed in the abdominal wall in about 15 per cent of the cases. It may be safely stated then that a more radical type of operation offers a better chance of permanent relief from the malignant disease.

When I remove a lesion situated in the first portion of the sigmoid I first freely mobilize the segment of bowel to be resected. Then a generous v-shaped portion of the adjacent mesentery is incised and the vessels are ligated in anticipation of removal of that part of the intestine. The mobilized diseased segment of sigmoid and mesentery is covered with gauze and brought out through the incision. Next, the wound is closed in layers in the usual manner, which consists of suturing the layers of the abdominal wall in such a way that they finally approximate closely the normal portion of the two limbs of the exteriorized colon. The wound is covered by moist gauze packs. Clamps are applied to the limbs of the protruding segment of bowel which is then amputated by means of cautery. In eighteen to twenty-four hours the proximal limb of colon is punctured immediately beneath the clamp. The clamps become detached automatically in five or six days; following this, a spur-crushing forceps is applied. After two to four weeks have elapsed, the colonic stoma is closed. This procedure seems more radical than the Mikulicz operation but it entails no more risk.

The combined abdominoperineal type of operation is frequently advocated as the procedure of choice for the removal of lesions of the pelvic portion of the colon; first, because it affords an opportunity for radical extirpation, and second, because it obviates the hazard inherent in segmental resection with anastomosis, i.e., the possibility of impairment of the blood supply to the ends of the proximal and distal segments of the colon. The combined type of operation necessitates creation of a colonic stoma of a permanent nature, which is always objectionable to the patient. Although a permanent colonic stoma is not the curse that it is many times thought to be, whenever possible, creation of an

artificial anus should be avoided. It is not a pleasant task for a surgeon to inform the patient that his difficulty is malignancy of the lower portion of the colon or of the rectum, and that the procedure necessary is an opening in the abdomen through which his bowel will be evacuated and that the rectum will be removed, for such patients receive an explanation which is doubly disheartening. First, many no doubt believed their trouble to have been due to the presence of hemorrhoids. They are at least slightly shocked when told the disturbance is of a much more serious nature than hemorrhoids. Then, as they attempt to recover from the first shock, they are informed that creation of a permanent colonic stoma is imperative.

An abdominoperineal or perineo-abdominal operation is, in my opinion, necessary in certain instances; for example, when a lesion of the upper portion of the rectum is present, particularly if the cancer is of high grade and in a young individual. I do believe, however, that the procedure has been employed in many cases in which the following method could have been utilized.

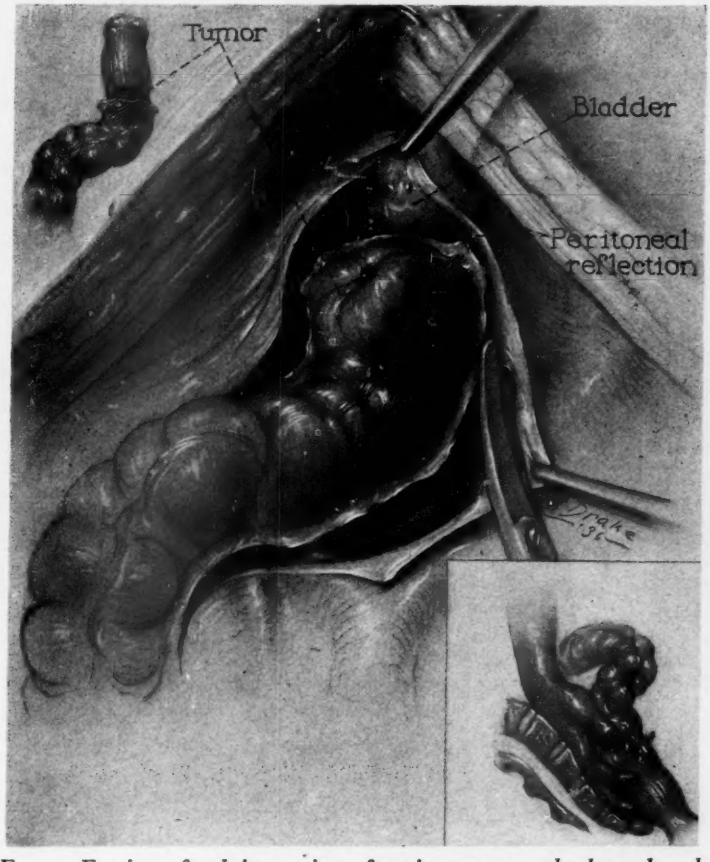

Fig. 1. Freeing of pelvic portion of peritoneum on the lateral and mesial sides of the sigmoid.*

During the past seven years I have been performing an operation which avoids creation of a permanent colonic stoma in cases in which it is necessary to resect part or all of the pelvic portion of the colon because of the presence of a malignant process. In order to remove a lesion occurring at or just proximal to the pelvic peritoneal fold in a radical manner and make an anastomosis, it is necessary to sacrifice the superior hemorrhoidal vessels, beginning at their site of origin by removal of gland-bearing tissue from the hollow of

* Illustrations from "Treatment of Cancer and Allied Diseases," edited by George T. Pack and Edward M. Livingston (Hoeber).

the sacrum, as is done in the combined abdominoperineal operation. It has often been stated that sacrifice of the hemorrhoidal vessels will cause necrosis of the rectosigmoid and rectum, but such has not been my experience. The method which I have employed permits removal of a part or all of the pelvic portion of the colon in a radical manner without permanent interference with the continuity between rectum and sigmoid; in other words, formation of a permanent colonic stoma is avoided. The technique which I have employed does necessitate emphasis on certain principles if satisfactory results and a low mortality are to be obtained. Nor is this operation set forth as a new procedure, but rather as a rejuvenation of the plan of segmental resection of the pelvic portion of the colon with reëstablishment of continuity, as described many years ago by Sir Rutherford Morrison and later by Balfour. In brief, their method consisted in removal of the diseased segment of bowel without preliminary colostomy. Anastomosis was made around a tube, one end of which had been passed upward through the lumen of the rectum into the proximal segment of the colon, this tube being held in place by tightly applied ligatures, which encompassed the proximal portion of the bowel and tube. Then the end of the tube protruding from the anus was drawn downward sufficiently to cause slight intussusception of the cut ends of the bowel, after which sutures were applied. The tube was allowed to remain in place for several days, usually eight to twelve.

Fig. 2. The sigmoid has been mobilized by freeing it from the tissues of the hollow of the sacrum.

The type of operation which I carry out has been employed for the eradication of lesions situated in the rectosigmoid, at or near the pelvic peritoneal floor, where obviously any type of exteriorization procedure is impossible. In practically all instances, the procedure is effected in stages. First, a low midline incision is made for the purpose of exploration. If the first portion of the sigmoid and its mesentery are sufficiently mobile, a left iliac stab wound is made and a knuckle of descending colon is brought out through the incision for the purpose of making a temporary colonic stoma. In many instances I have found it more practicable to make a small stab wound in the midline in the upper abdomen, and to exteriorize a small segment of the transverse colon to provide a temporary colonic stoma.

The second stage of the operation is performed after two or three weeks have elapsed, and at this time the low midline approach is again utilized. The peritoneal reflection of the pelvic mesocolon is incised, beginning mesially at the level of the origin of the superior hemorrhoidal vessels and then laterally, beginning 4 to 6 inches (10 to 15 cm.) above the level of the superior iliac crest. Next, the peritoneal incisions are extended downward to the pelvic floor to meet horizontally across the base of the bladder in males or the posterior aspect of the cervix in females. (Figs. 1 and 2.) The ureters are identified and isolated. Then the superior hemorrhoidal vessels are ligated near their site of origin. Care must be exercised that the ligature is placed distal to the origin of the sigmoidal

arteries. Should ligation be carried out above the origin of the sigmoidal vessels, impairment of the circulation to the proximal segment of bowel is likely to occur. The entire pelvic portion of the colon is now mobilized by manual elevation of the gland-bearing tissues from the hollow of the sacrum. Rubber-guarded (half-circle) clamps are applied and amputation of the diseased segment is carried out. (Fig. 3.) Next, an end-to-end anastomosis is made between the first portion of the sigmoid or the lower end of the descending colon and the upper end of the rectum or rectosigmoid, depending on the extent of the resection. (Fig. 4.)

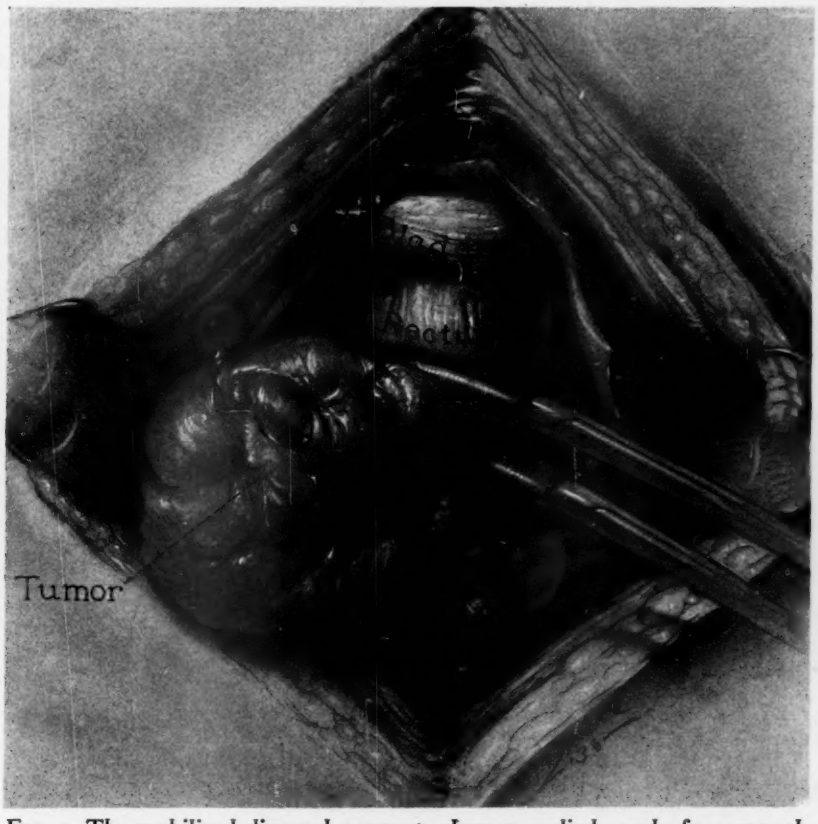

Fig. 3. The mobilized diseased segment, clamps applied, ready for removal.

As has been implied, the blood supply to the proximal portion of the anastomosis comes from the inferior mesenteric and sigmoidal vessels, whereas the blood supply to the distal segment (rectum) is maintained through the middle and inferior hemorrhoidal vessels. The next step is to approximate and suture the peritoneal leaves to the sides of the proximal segment of the colon, forming a reconstructed and more shallow pelvis than was present before. Almost invariably, the line of suture of the anastomosis is situated below the peritoneum. A Penrose cigarette drain is used, one end of which is passed through the newly constructed peritoneal floor into the hollow of the sacrum and the other is brought out suprapubically. In the majority of cases the colonic stoma is closed after a lapse of three or four weeks following resection.

The procedure just described seems to me to be as radical in nature as the combined abdominoperineal operation, with the exception that the rectum, and in some instances a small portion of the lower sigmoid, is preserved. Many cases have been observed in which an anterior resection of the sigmoid was done because of the presence of a malignant process, using the proximal end of the descending colon for a permanent single-barrel colonic stoma, the

rectum being left in situ undisturbed. According to my observations, when death has intervened as the result of either recurrence or metastasis, involvement of the rectal segment has been strikingly infrequent. This emphasizes again a feature generally recognized, namely, that the spread of malignancy of the colon is, for the most part, upward in the direction of the return blood flow, and therefore, it seems justifiable to preserve the rectum and utilize its function whenever possible. A short mesosigmoid is a definite disadvantage in carrying out segmental resection of the pelvic portion of the colon with reëstablishment of continuity of the intestinal tract. Marked fixation of the rectum and rectosigmoid also adds to the difficulty of technical performance.

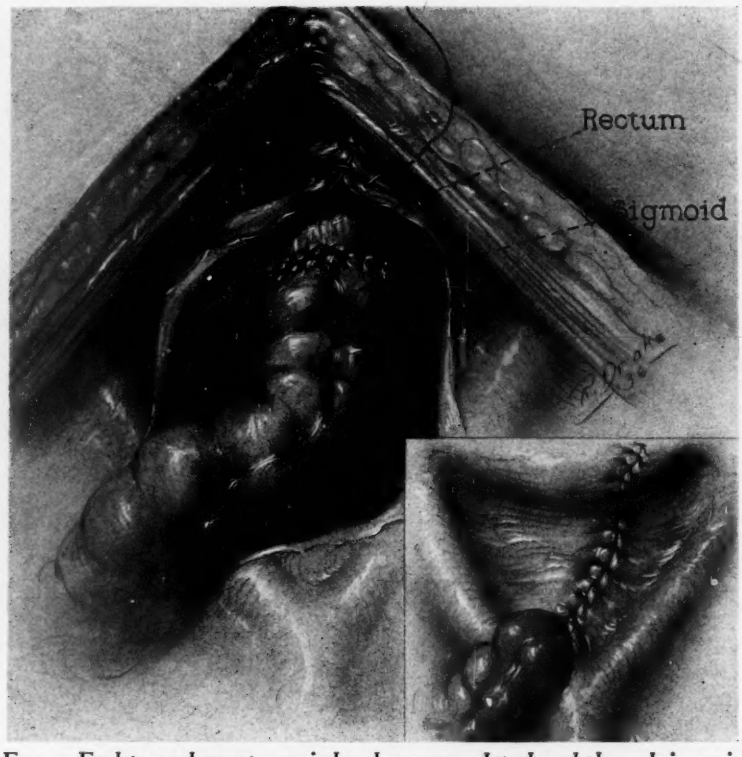

FIG. 4. End-to-end anastomosis has been completed and the pelvic peritoneum is being reconstructed in such a manner as to permit placing of the anastomosis beneath it.

During the past seven years I have carried out more than 100 operations of this type. Not infrequently the anastomosis can be felt upon digital examination of the rectum. In the majority of instances, the lumen of the bowel in the site of union of the segments is somewhat smaller than normal, but I have not observed a case in which narrowing of the lumen was of such degree that closure of the colonic stoma seemed inadvisable. In three cases subsequent colostomy was necessary because of recurrence of malignancy in the pelvis, causing obstruction of the colon. In these instances small malignant tubercles were present over the pelvic peritoneum at the time of resection and, even though radical measures were carried out to remove these tubercles, it was realized that the procedure would, most likely, be only of a palliative nature. In two cases, two years or more elapsed before recurrence was evident; in one, less than a year passed before obstruction again occurred in the lower part of the colon. The procedure carried out in this small group of cases seemed justified because there was no evidence of malignant involvement of the liver. The most grateful postoperative patients I know are those for

whom resection of a portion of the colon has been carried out with reëstablishment of continuity of the bowel. The colotomy so necessary as a first-stage procedure has allowed them the opportunity of experiencing the presence of an artificial anus.

An operation similar to the one herein described has been carried out through the perineum by Babcock and others. In that procedure, the pelvic and lower descending segments of the colon are mobilized; then, through the perineum, an incision extending from the tip of the coccyx to the anus is made, the mobilized diseased loop of bowel is withdrawn, a segmental resection is performed and an end-to-end anastomosis is established. The difficulty of this procedure, I believe, is that the convalescence is markedly prolonged, and because of the perineal incision, the nerve supply to the sphincteric mechanism of the rectum is frequently extensively damaged.

CONCLUSIONS

The risk entailed in the operation I have employed is appreciable but the mortality is lower than that accompanying the combined abdominoperineal operation. I believe the reasons existing for performing anterior segmental resection of the rectosigmoid and sigmoid with reëstablishment of continuity of the bowel are sufficiently sound to warrant its application in many of the cases in which the combined operation with creation of a permanent colonic stoma, is employed. Beyond all question the procedure I have described herein is far more acceptable to the patient, and probably it is actually as effective as the combined procedure, which is generally considered to be more radical.

CANCER OF THE RECTUM AND RECTOSIGMOID: DIAGNOSIS AND TREATMENT

FRED W. RANKIN, M.D. AND A. STEPHENS GRAHAM, M.D.

LEXINGTON, KENTUCKY

THE late Daniel Fisk Jones truly stated "There is no disease that can be diagnosticated with more accuracy than cancer of the rectum after the patient once presents himself, and yet there are few diseases which are diagnosticated so late in their course." He might well have added, especially since he was to so great an extent responsible for the change, that there are few diseases for which the prospects of cure have so markedly increased in the past two decades as for carcinoma of the rectum. This progress has not been in the realm of surgical technique alone, but includes also a tremendous advancement made in roentgenologic technique, more meticulous coöperative preparatory efforts, refinements in anesthetic methods, and a recognition of the significant part played by adenomatous polyps in the genesis of carcinomas of the large intestine.

The problems involved in arriving at a diagnosis of carcinoma of the distal segment of colon and rectum are not dissimilar to those surrounding ulcer of the stomach and duodenum. Seldom is an attempt made from the anamnesis alone to differentiate between the two. A preliminary diagnosis of peptic ulcer serves the purpose of indicating the probable existence of an organic lesion in the upper gastrointestinal tract, the exact nature and location of which can be determined conclusively only through roentgenologic studies. Similarly the colonic syndrome of organic disease—rectal bleeding and altered bowel habit—should be universally accepted as an indication for a painstaking investigation of the lower gastrointestinal tract, including digital, sigmoidoscopic and radiologic examinations, for there are no symptoms that one might designate as being pathognomonic.

Blood, usually bright to dark red, mixed with the stool or appearing as simple streaks on it, or in varying quantities with discharges of mucus and small flakes of fecal material, may have as its origin a malignant lesion of the left half of the colon or the rectum, or hemorrhoids, or diverticula of the colon, or benign polyps, or benign ulcers. Yet, since bright blood is almost universally recognized as the most significant first indication of cancer of the rectum, physicians would do well to assume the probable existence of malignancy in every patient who reports such a finding. It is our confirmed belief that almost every patient, if not all of them, in whom a diagnosis of cancer of the rectum has been made passes bright blood at stool. Bleeding had been noted by the patients in 78 to 89.5 per cent of series of cases reported by Rosser, Brindley, Buie, and by one of us (Rankin). Browne recently stated that in the rectal cases of his series it was universal. Similarly, one of us (Graham) has been able to obtain evidence of rectal bleeding in all of his most recent thirty-eight cases diagnosed carcinoma of the rectum or sigmoid. It is significant to note, however, that only 78 per cent of these patients themselves had noted blood at stool when first questioned. The observation in the remaining 12 per cent was made by members of the hospital staff. To the usual question "Have you ever passed bright blood at stool?" the patient not infrequently answers "no." Yet to the next question "Do you ever observe the passages from your bowel?" The answer is just as frequently "no." The inconsistency of

such answers long ago led us to require patients whose complaints suggested disease of the large intestine, to observe carefully their stools or to enter the hospital that we might make such observations.

Constipation, persistent in character and progressive in degree, may be the result of altered metabolic processes accompanied by progressive atony of the musculature of the colon, or it may be due to pelvic pathology such as a gradually enlarging, retrodisplaced uterus or ovarian cyst, or external constriction of the pelvic colon produced by an endometrial growth, or to many and varied conditions among which is carcinoma of the rectum. Patients, however, attach less significance to such disorders than to bleeding and are prone to temporize with increasing constipation or diarrhea until tenesmus and abdominal discomfort influence them to consult a physican. It will be noted from the following excellent description of a slow, progressing, constricting cancer of the rectum, written in 1810 by Thomas Copeland, that 130 years have not altered the basic problems involved in arriving at a diagnosis of cancer of the rectum:

"The first symptom of the disease is an habitual costiveness; but this is so frequent in occurrence and produced in so many ways that it is not likely that the cause should be sought for in an organic affection of the rectum. Mild purgation is resorted to, and the symptoms being relieved, the cause is no longer sought after. When this has subsided for some time the patient complains of what is called piles, and what is often really so, as a consequence of obstructed circulation in the parts."

In a series of cases of cancer of the colon reported by one of us (Rankin), constipation was the predominant complaint in 332, or 55 per cent. Rosser in a similar series of cases reported an incidence of 61 per cent.

Diarrhea is encountered in a great variety of disorders, such as achlorhydria, colitis, dysentery, congenital adenomatosis, and in carcinoma of the large intestine, particularly of the rectosigmoid, as the lumen of the bowel becomes encroached upon. Diarrhea was the cardinal complaint in 22 per cent of Rosser's cases of cancer of the rectum, in 20 per cent of a series reported by one of us (Graham). In these two series the complaint of diarrhea led to a diagnosis of dysentery or colitis in 17 per cent and 15 per cent of the cases, respectively.

The terms "constipation" and "diarrhea" are a source of considerable confusion during the process of questioning the patient. The direct question as to the number of stools each day may or may not elicit this information satisfactorily. These patients will often deny constipation, notwithstanding the daily intake of large doses of purgative medicine necessitated by their inability satisfactorily to relieve themselves by defecation. Consequently the usual simple question, "Do you have a daily bowel action?" or "How often do your bowels move?" are inadequate. In denying constipation the patient will frequently state that to the contrary they suffer from diarrhea. When diarrhea is the prevailing symptom, however, the history may be misleading, as the average patient is likely to consider anything diarrhea from a frequent desire to go to stool to ten or more large, watery stools a day. Actually, diarrhea seldom occurs. These frequent movements often consist only of a minimum quantity of water matter, mucus, and probably blood, and represent the so-called compensatory or pseudodiarrhea which manifests itself in the face of almost complete obstruction. Careful questioning of patients will often elicit a history of a preceding protracted constipation for which they resorted to energetic purgation. We have been forcibly impressed with the considerable number of patients who have been treated over long periods of time for amebic dysentery, chronic ulcerative colitis and other disorders in the course of which have been administered yatren, stovarsal, emetine, Bargen's specific vaccine and serum and sulfanilamide—to mention just

a few forms of medication employed—and who have been subjected to so-called high colonic irrigations consisting of a great variety of antiseptic solutions. Yet in almost every instance an annular growth could be felt with the examining finger, while the remainder were readily visualized through the proctoscope. Moreover, inspection of the rectal discharges of these patients by ourselves or by experienced assistants, which is our invariable practice in such cases, has demonstrated that in a majority of instances the quantity of the individual passages rarely exceeded half an ounce and that the amount of fecal material expelled in twenty-four hours seldom totalled 1 ounce. The bulk of the material passed was mucus.

The so-called ribbon stools possess no significance as regards carcinoma of the rectum. They depend upon the tonicity of the anal sphincters and are seen in cases of constipation more often than in cases of organic disease.

Severe pain is seldom a prominent symptom until the malignancy is far advanced or the anal canal, which alone is endowed with pain sensation, is involved. Moderate degrees of pain not infrequently are associated with ineffectual peristaltic activity and the accumulation of gas in instances of a markedly stenosed bowel lumen, particularly at the rectosigmoid. Excessive loss of weight and strength seldom are encountered in patients in whom the rectal lesion is operable. Fifty-six per cent of 300 cases studied by Rankin and Jones were of normal weight or obese at the time of examination, which averaged eleven and seven-tenths months after the onset of symptoms.

Although marked secondary anemia is of rare occurrence in instances of carcinoma of the rectum (Rankin and Jones reported an average hemoglobin reading of 72 per cent in their series of 300 operable cases), a wide variation in the hemoblogin reading will be noted in individual cases. Moreover, in determining operability or prognosis very little significance can be attached to readings of the hemoglobin. Illustrative of this fact is the following experience of one of us (Graham) with five consecutive cases simultaneously hospitalized. Case I, weight normal, hemoglobin 96 per cent, inoperable because of glandular and hepatic metastasis; Case II, 24-pound weight loss, hemoglobin 72 per cent, definitely operable; Case III, weight normal, hemoglobin 102 per cent, glandular involvement, died nine months after palliative resection; Case IV, recent gain in weight, numerous moderate rectal hemorrhages, hemoglobin 106 per cent, operable; Case V, 30 pound loss in weight, numerous moderate rectal hemorrhages, hemoglobin 76 per cent, definitely operable. The determinations of hemoglobin were all carried out in the same laboratory by trained technicians and by one of the more accurate methods. It is quite evident that repeated hemorrhages in one instance produced secondary anemia and in another stimulated the production of hemoglobin.

In the final analysis the diagnosis will depend on a careful examination of the patient by methods available to every physician, namely digital examination and proctoscopic visualization of the rectum and rectosigmoid.

TREATMENT

When one has established an accurate diagnosis of cancer of the lower gastrointestinal tract, the question of treatment demands, first, an evaluation of the types of therapeutic agents at hand, and second, a decision as to whether radical or palliative measures shall be adopted. By and large, it is now accepted that radical surgery in operable cases of cancer of the rectum is the procedure of choice among curative maneuvers. True, in the aged, poor surgical risks, and in certain pathologic types of growths readily accessible to local treatment, diathermy occasionally is useful. Radium has its place in the treatment of malignancy in this location because it can eradicate certain types of lower rectal growths without sacrifice of the

sphincteric mechanism, and can occasionally convert an advanced, fixed, inoperable growth into an operable tumor, or if the growth has not metastasized when destroyed, even effect an occasional cure. That the power of radium, however, is variable and controlled with difficulty, is well known, and the dangers in its use make it an unsuitable agent for general employment and safe only in the hands of experienced operators. Coöperation between surgeons and radiologists unquestionably will in the near future more accurately evaluate its place, but at the present time it seems a fair position to take that radium has a very small field of applicability in the operable group of rectal and rectosigmoidal cancers.

Surgery then, is the agent of choice and its limitations are fairly rigidly established. Operability curves and secondarily mortality figures are influenced, first, by the location, mobility, and extent of the growth; second, by the presence of obstruction; third, by the presence or absence of metastases; and fourth, by the age, general condition and presence or absence of concurrent debilitating diseases.

Palliative measures usually are confined to decompressive procedures. Obstruction, which is present in the vast majority of cancers of the rectum of any long standing, plus fixation and general debility, call for colostomy or cecostomy. The question of resection in the face of hepatic metastases is a difficult problem to decide. Death from intestinal cancer, which has progressed to fixation, attachment to other viscera, invasion of neurogenic elements, and obstruction, is a most unpleasant and painful demise. On the other hand, the liver may be filled with cancer, hepatic function diminished, physiologic equilibrium undermined, and the individual die comfortably from weakness and asthenia but without pain, if the original growth is removed. In consequence, it ofttimes is justifiable to remove a growth which is operable but which has metastasized, if the removal can be done with a mortality figure acceptable for operable cases. The decision to do any type of operation, and particularly a palliative operation, should be regulated by the dictum that the risk of the operation should not be greater than the risk of the disease.

Obstruction. Intestinal obstruction from left colonic and rectosigmoidal growths is a common occurrence. One would expect this when it is remembered that the tumors in this location of the bowel frequently are encircling, that the anatomic conformity of the bowel is narrower and more muscular than in the rest of the colon, and that the content of the bowel is solid, formed fecal material; that the sigmoid enters the top of the rectum at the rectosigmoid juncture at an angulation and that the rectosigmoid juncture usually is a fixed anatomic segment without mesentery. The group of acute intestinal obstruction cases found in the left colon and the rectosigmoid represents somewhere between one-fourth and one-half of the whole group of cancers of the left colon and rectum.

Often obstruction appears out of a clear sky, the individuals are rushed into the hospital with a diagnosis of acute intestinal obstruction without cancer being suspected, and operative decompression after attempts at medical relief become imperative. In this connection, it has seemed useful to us to use blind cecostomy done through a right McBurney incision under local anesthesia.

It may be mentioned in passing that immediate decompression by cecostomy often is a difficult procedure because of the local conditions and that the technique of performance of this operation differs materially from that utilized when it is employed as a complementary procedure. The cecum, under conditions of acute intestinal obstruction may be, and frequently is hugely distended, half filled with liquid feces, and apparently almost at the bursting point from pressure of intracolonic gases. Such an organ does not lend itself readily to manipulation without danger of rupture, and efforts to suture this type of

bowel often result in decompression, for sooner or later the needle point will enter the lumen and a whistle of gas announces the accident to the surgeon. It is better under such circumstances to seal off the anterior bowel wall with packs, deliberately puncture the cecum with a needle and allow the gas to escape. Then one may either deliver the cecum outside the wall, put a tube under it, and suture it to the peritoneum or introduce a large rubber tube after Witzel's technique.

When one eliminates colonic obstruction and confines the group to rectal cancers, the utility of cecostomy is still obvious. Most rectosigmoidal cancers produce obstruction, either chronic, subacute or acute, during the time of their presence. This obstruction usually can be relieved preoperatively by medical management, but not infrequently at exploration the surgeon finds a thickened, hypertrophied bowel proximal to the growth, surrounded by multiple telangiectases, enlarged lymphatics and with edematous tissues in the mesentery which indicate that the stenosis is not completely relieved. Under such circumstances, a cecostomy performed as above is a desirable first stage of a graded procedure. Whipple, in 1931, reported a number of cases done by this method as a deliberate first stage of graded operations for graver risks, and our own experience in a number of instances where decompression had not been adequately accomplished prior to exploration, has convinced us of its utility and the satisfaction of its employment. Employing cecostomy under these circumstances, one relieves the obstruction, drains the bowel, and places the stoma as far away from the midline as possible to advantage subsequent resection.

For these reasons it is more useful than colostomy under certain circumstances, and although it may require an operative procedure for closure, such an operation may usually be carried out under local anesthesia and with small discomfort to the patient and no additional loss of time in the hospital.

Choice of Operation. Many factors enter the choice of a technical procedure, such as the skill, judgment, boldness and personal prejudices of the surgeon and the estimation of the patient's ability to undergo surgery up to a certain limit. Individualization of patients by fitting them into the proper type of operation at exploration influences the final decision in selection. Happily there is no longer any disagreement as to the desirability of certain fundamental principles in all cases brought to operation after careful scrutiny. Radical removal of the offending growth with block dissection of the adjacent gland-bearing tissues, and secondary acceptance of colostomy as a necessary part of such a maneuver, no longer are questioned as essential features of the offensive. There still remain a few surgeons who for one reason or another advocate, in print at least, segmental resection or anterior resection with subsequent reëstablishment of the gastrointestinal continuity; or posterior exteriorization procedures, or some other novel type of operation which saves the sphincter muscle, but in the main the surgical world rarely dissents from the dictum that a colostomy is a necessary part of any radical curative operation for cancer of the rectum. It is unfortunately true that the general practitioner who first sees cancer of the rectum and either makes or suspects the diagnosis, is far from being universally convinced of the necessity or desirability of this step.

The technique of manufacture of a colostomy has advanced markedly in the last quarter of a century and nowadays a properly made stoma need give the patient small room for complaint save during attacks of diarrhea. A better understanding of diet and a more thorough knowledge of the proper method of handling the colostomy have done away with many of the objections to its employment and it is now widely recognized that the possessor of an artificial anterior anus no longer need suffer social ostracism or professional incapacity.

The location of the growth exerts an important influence in the selection of operation because two out of three rectal cancers are either high in the rectum or low in the sigmoid. Approximately 66 per cent of the whole group are within an inch of the peritoneal reflection either intraperitoneally or extraperitoneally. Thus it becomes increasingly apparent that only an operation which will remove tissues in all the zones of spread and particularly in the upward zone, namely, the mesentery of the sigmoid, can be employed to eradicate the malignancy in a high percentage of cases. One other factor which should exert an enormous influence toward the selection of the radical combined procedure in any case to which it may be applied with reasonable satisfaction, is the factor of glandular involvement. More meticulous methods of searching for cancer cells in resected specimens have proved beyond doubt that a huge percentage of cancers of the rectum have already metastasized at the time of operation. Ten years or more ago Broders and Rankin reported on the glandular metastases in 300 cases of cancer of the rectum and found involvement in 45 per cent. More recently Gabriel, Dukes and Bussy at Saint Mark's hospital have reported a series of resected specimens showing 65 per cent of involved glands. In May, 1938 David and Gilchrist before the American Surgical Association reported a series of cases of cancer of the rectum in which 68 per cent of the resected specimens showed glandular involvement. This rising curve of glandular metastases is the result of more painstaking and meticulous methods of examination.

It is axiomatic that no one procedure will ever be applicable to all types of cancer in this location, particularly since patients present themselves in various stages of the disease and in different physical states. However, increasing experience buttressed by statistical studies indubitably indicates that radical extirpative maneuvers either in one or several stages which eliminate the local growth and contiguous tissues, sacrificing a large part of the mesentery of the sigmoid and establishing a colostomy, are preferable to other varieties when they are acceptable under tests of modern operability.

The choice of operation in the average case of cancer of the rectum lies between: (1) combined abdominoperineal, or perineo-abdominal resection in one or two stages; and (2) Lockhart-Mummery's operation of colostomy and posterior resection. Numerous other procedures are advocated, varying from perineal excision with perineal colostomy or segmental resection with or without preservation of the sphincter, to local excision, but by and large their popularity has not been extensive. The present day attitude toward the combined operation has come about because of the reduction of mortality to a plane comparable with that of the less radical procedures. It is hardly likely that so formidable a procedure as a combined resection of the rectum, either in one or more stages will ever become routine and safe in the hands of casual operators, but in this day of specialization more and more general surgeons have mastered its technique and coupled this experience with a meticulous preoperative preparation and postoperative care period to a point where it may be used advantageously and widely. Unquestionably there is a wide field of usefulness for the operations of both Miles and Lockhart-Mummery.

Mortality and Operability. Operability curves and mortality figures and data on end results are inextricably interwoven, for the ultimate outcome following surgery depends upon both the radicalness of the operation and the time at which it is done. Operability or resectability has a most important bearing upon hospital death rates as well as prognosis, for an operable case in one surgeon's hands may be abandoned entirely or treated with a palliative side-tracking operation by another less bold or less experienced. In the hands of mature, trained surgeons, operability is limited largely by: (1) hepatic metastasis;

(2) fixation of the growth; and (3) general systemic conditions affecting the individual's resistance to surgery. The latter, termed "extrinsic" influences, must be well weighed in accepting for radical surgery a debilitated individual; cases with hepatic metastasis must be placed in a separate category. By and large, it is a fair rule to accept for resection all patients with growths not immovably fixed, or requiring double resections or otherwise complicated by perforation, abscess formation, etc. To give to the greatest number of patients a chance to recover from cancer by surgery, makes it necessary to extend the limits of operability to a point where they include the borderline cases and occasionally an inoperable case which has metastasized to the liver but is still locally removable, with a reasonable risk.

It is a very noticeable fact gleaned from a study of statistics over the past two decades that in the hands of all surgeons experienced in this type of surgery, the resectability rate is steadily rising. At the Saint Mark's Hospital, Gabriel reported a series of cases operated upon over the years of 1910–1920, finding 41.6 per cent to be operable. The next decade from 1921–1931 saw the operability rate rise to 54 per cent. In our service the operability rate of around 50 per cent prior to 1930, had by 1935 risen to 74.8 per cent. This has been the experience of other surgeons both upon the Continent and in America, and represents a laudable attempt to apply radical surgery to cancer of the rectum, keeping within compatible bounds the hospital death rate.

Mortality following resection for cancer of the rectum is influenced not only by the selection of cases for operation, but also by the type of surgery employed. It goes without saying that the more formidable "combined" operations, whether in one or two stages, carry a higher mortality rate than the less radical perineal excisions. Nevertheless, it is provable statistically that in the hands of experienced surgeons the difference in mortality rate is comparatively small and the argument may also be advanced that the advantages over a term of years which accrue to the patients upon whom the more radical procedures are done, far outweigh the smaller hospital death rate. In 1933, Lockhart-Mummery reported on 300 consecutive cases of perineal excision by his method, having a mortality of 7 per cent. D. F. Jones reported a mortality for the combined operation in 136 prvate cases, of 12.5 per cent. T. E. Jones, in a group of 151 one-stage combined operations, had a mortality of 7.2 per cent with an operability rate of 63 per cent. Table 1 from the service of one of us (Rankin) shows not only the resectability rate in a series of 191 cases but also the choice of operation and the operative mortality. From this table it is evident that the trend toward radical operation in one-stage has been carried out in two-thirds of the cases. Moreover it is interesting to note that there is slight difference between the mortality of the one-stage combined operation and colostomy and posterior resection in this series. The resectability rate of 75 per cent represents an horizon of operability which, although desirable to maintain, may not prove routinely feasible. It is difficult to evaluate the factors

Table 1

	Cases	Deaths	Per Cent Mortality
One-stage combined resection	99	7	7.07
Colostomy and posterior resection	38	3	7.8
Colostomy alone or with exploration	35	6	17
Exploration alone	10	0	
Two-stage combined	06	0	
Cecostomy (acute obst. due to ca.)	03	1	
	191	17	

Patients	191
Operations	234
Resections	143
Resectability	74.8 per cent
Mortality	8.9 per cent

influencing prognosis without entering into considerable detail, but consonant with the trend toward more radical surgery one finds five year cures increasing in proportion to the application of formidable maneuvers and favorably influenced by early diagnosis. When it is realized that five year cures from sphincter saving operations are approximately 33 per cent, whereas the more radical procedure of one-stage combined abdominoperineal (Abel) shows 63.4 per cent, it becomes increasingly apparent where the advantage lies. Yet common sense and good judgment indicate that between these two extremes lies a large group of cases which must be done by other well selected types of operation, and which will show an average of between 40 and 50 per cent of five year cures. While unquestionably great strides have been made in the past two decades in the surgical treatment of rectal cancer and while one may view with optimism the progress toward the more radical treatment and better end results, it must be recognized that the problem still remains a vastly important one which demands the combined best efforts of practitioner, pathologist, and surgeons.

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THE PROBLEM OF THE SURGICAL TREATMENT OF CANCER OF THE RECTUM

W. ERNEST MILES, F.R.C.S. (ENG.), F.R.C.S. (IRE.), F.A.C.S.

Senior Surgeon, Gordon Hospital for Diseases of the Rectum and Colon; Consulting Surgeon, Royal Cancer Hospital

LONDON, ENGLAND

AN operation undertaken for the eradication of cancer must be based on pathologic findings in regard to the spread of cancer cells to surrounding tissues from the primary growth. If the operative field is not sufficiently extensive to embrace the whole of the tissues that are known pathologically to be prone to invasion by cancer elements which have become detached from the primary focus, then the operation will be doomed to failure, because it will not prevent recurrence.

The whole question, therefore of the operative treatment of cancer of the rectum hinges upon the knowledge, first of the manner in which cancer of the rectum spreads, and secondly, of the paths along which that spread takes place.

THE SPREAD OF CANCER OF THE RECTUM

As the result of (1) noting the position of metastases in the extramural tissues during the performance of primary operations; (2) observing the structures that were the site of metastases during the performance of secondary operations; (3) recording the extent and the position of metastases in cases in which a proposed operation had to be abandoned on account of their existence; (4) studying the post-mortem findings in regard to the spread of cancer in those who had died from advanced and inoperable cancer, and (5) by the minute dissection of specimens removed by operation, I was enabled, in a paper read at the meeting of the British Medical Association in 1910, to point out that during the process of growth cancer of the rectum spreads in three distinct ways: (a) by direct extension through continuity of tissue; (b) through the venous system; and (c) by means of the lymphatic system.

Direct Extension through Continuity of Tissue. This takes place in two directions: (1) on the mucous surface of the bowel progressively from its entire margin, and (2) through the thickness of the bowel wall. The marginal increase is generally greater and more rapid in the transverse direction than in the longitudinal axis of the bowel. It is not uncommon to find that, whereas nearly the whole of the circumference of the ampulla has been invaded, the extent of the growth longitudinally is less than 2 inches. The growing edge undermines the more normal mucous membrane extending in the submucous tissue deep to the muscularis mucosae. Such surface extension is comparatively slow: thus, in the ampulla, for instance, it will take about six months for the growth to travel round a quarter of the circumference in an average case. While surface extension is slowly progressing, the more important deep infiltration of the muscular coat of the bowel is taking place, and appears to be a slow process.

When the bowel wall has been penetrated the growth invades the perirectal fat, through which it extends until it reaches the fascia propria of the rectum. According to my observations upon this point the fascia propria is not usually penetrated until the disease has existed long enough for more than three-quarters of the ampulla to have been encompassed, thus indicating that it has been in existence for about eighteen months. It is only after penetration of the fascia propria that invasion of neighbouring structures such as the sacrum, uterus or vagina, prostate or bladder

can take place; and it would seem that involvement of adjacent structures by direct extension does not occur until the expiration of at least a year after the initial appearance of objective symptoms. It will be seen, therefore, that the mode of spread through continuity of tissue is a comparatively slow process, and that direct invasion of neighboring structures does not take place until the growth in the rectum has involved the greater part of the circumference of the bowel.

If extension of cancer through continuity of tissue were the only or even the usual mode of spread from the rectum, the surgical treatment of the disease would be quite simple, because, unless the growth has extended beyond the confines of the fascia propria, a restricted operation, entailing nothing but the removal of the portion of the musculomembranous tube containing the cancer in its interior, would be all that was necessary to rid the patient completely of his disease. Unfortunately however, other and more important modes of spread take place simultaneously and with greater rapidity, leading to distant dissemination even when the primary growth is still in an early phase of development.

Through the Venous System. There is no doubt whatever that cancer cells sometimes penetrate into the interior of small veins and becoming detached are carried in the blood stream. The actual invasion of a venous radical is occasionally seen in microscopic sections of carcinomatous tumors. As the rectal veins belong to the portal system, cancer cells penetrating them are carried straight to the liver. The metastasis thus produced by an embolus of cancer cells is single and is usually situated in the middle of the right lobe of the liver. It is fortunate that dissemination by the veins is very rarely encountered, so that in practice we can disregard the possibility of its occurrence.

By Means of the Lymphatic System. Infinitely more important is the dissemination of cancer cells through the lymphatic channels, and a knowledge of the lymphatic system is essential to the performance of any radical operation on cancer.

ANATOMY OF THE LYMPHATICS OF THE RECTUM

The rectal lymphatics are arranged in three groups, intramural, intermediary and extramural.

1. The intramural lymphatics are contained in the wall of the rectum and consist of two distinct networks, one situated in the submucous tissue and the other between the muscular layers. The two networks communicate freely with one another by means of short radial channels which pass through the circular muscular coat. The submucous network of the ampulla is continuous above with that of the pelvic colon and below with a similar network in the anal canal. The latter is also in communication with the lymph plexus in the subcutaneous tissue of the perianal skin, from which collecting stems pass forward, in the furrow between the perineum and the inner aspect of the thigh, to terminate in the innermost of the horizontal set of inguinal glands. The intermuscular network of the rectum communicates above with that of the pelvic colon and below with the lymphatics of the external sphincter muscle. The collecting stems traverse the external muscular coat of the rectum and terminate in the lymph channels of the intermediary system.

2. The intermediary lymphatic system consists of two parts, namely, a subserous network in the portion of the rectum which is covered by peritoneum, and a lymph sinus, situated between the external muscular coat and the perirectal fat in that part of the rectum which does not possess a peritoneal investment. The lymph sinus can always be demonstrated in any specimen of the rectum which retains its coverings of perirectal fat. It is not a free space, but is occupied by a delicate wide-meshed reticulum consisting of fine strands of connective tissue. It is possible that the connecting stems from the intermuscular network, after traversing the external coat,

empty themselves directly into this lymph sinus instead of passing across it.

3. The extramural lymphatic system is the most important of the three. The collecting stems from the lymph sinus form an extensive plexus and enter into relation with the anorectal glands of Gerota, which are scattered over the surface of the rectum among the branches of the superior hemorrhoidal vessels. The efferents from this plexus and from the anorectal glands pass to their ultimate destination in three directions, namely, downward, laterally, and upward.

The downward efferents traverse the fatty tissue of the ischiorectal fossa in company with the inferior hemorrhoidal vessels, enter into relation with a small group of lymph nodes situated close to the exit of Alcock's canal, then pass through the canal and empty themselves into the internal iliac glands. The lateral efferents enter a plexus situated between the levator ani muscles and the pelvic fascia from which collecting vessels pass to the obturator gland, situated at the upper border of the obturator foramen. The efferents from the obturator gland pass to the internal iliac glands and to the innermost of the group of glands accompanying the external iliac vessels.

The upward main efferents accompany the superior hemorrhoidal veins, enter the lowermost mesocolic (retrorectal) glands, then accompany the inferior mesenteric vein as it lies in the parietal border of the pelvic mesocolon and finally enter the group of glands situated at the bifurcation of the left common iliac artery and also the median lumbar (aortic) glands. Some of the efferents from the uppermost part of the plexus enter into relation with the paracolic glands situated along the mesenteric border of the pelvic mesocolon, from which collecting stems accompany the sigmoidal vessels to end in the median lumbar glands.

Such being the anatomic arrangement of the lymphatics in connection with the rectum, the tissues through which the lymphatics pass are liable to be invaded by cancer cells which have become detached from the primary growth.

The spread of cancer cells in the submucosa of the rectum is very limited and does not extend more than a few lines beyond the microscopic margin of the growth. Spread in the intermuscular lymphatics is just as limited. Both clinical and histologic observations show that the intramural spread is always of comparatively trivial extent. It is, therefore, probable that detached cancer cells pass through the bowel wall somewhat rapidly by means of the intramural lymphatic system, and having entered the external lymphatics, give rise to extramural metastases scattered over a wide area long before the muscular coat has been penetrated by direct extension of the growth.

The direction in which the cells travel is largely influenced by the direction of the current in the lymphatics which have been invaded. It must be remembered, however, that the path by which the cells advance is not entirely controlled by anatomic considerations. Thus, it may happen that cancer cells derived from a growth in the rectum, wherever situated, may traverse the lymphatics in a downward, lateral, or upward direction, or in all three directions simultaneously. During the transit their progress may be arrested at any point in the region traversed by the lymphatics and so lead to the formation of nodules. The various tissues through which the lymphatics pass, therefore, are prone to metastatic deposit, which is either macroscopic or microscopic in character. It may be regarded as an axiom that whenever a visible metastasis exists, other metastases, which cannot be recognized without the aid of the microscope, also exist along the course of the lymphatics, at points more distant from the seat of the primary growth.

There are three distinct extramural paths along which cancer cells invade the neighbouring tissues, constituting what may be termed zones of spread.

1. *The Zone of Downward Spread.* The structures comprised in this zone are the perianal skin, the ischiorectal fat and the external sphincter muscle. Owing to the free intercommunication between the lymphatics of those structures and the efferents from the rectum, it is easy to understand how the progress of a detached cancer cell may be arrested at any point in that extensive network. It is also apparent that even an exhaustive microscopic examination of the structures above mentioned might fail to detect such isolated cancer cells. Nevertheless, the presence of minute masses of cancer cells has been revealed in microscopic sections often enough to establish the fact beyond doubt that these structures are liable to be invaded during the process of dissemination.

2. *The Lateral Zone of Spread.* This area embraces the structures whose lymphatics enter into relation with the extensive lymphatic network between the levatores ani and the pelvic fascia. These structures are the levator ani muscles, the coccygei, the pelvic peritoneum, the prostate gland, the base of the bladder, the cervix uteri, the base of the left broad ligament and the internal iliac glands. The levatores ani are sometimes the seat of metastases. I have encountered them in the substance of the muscle close to its attachment to the rectum and also near its origin from the pelvic wall during the performance of excision operations, both primary and secondary. These muscles are exceedingly prone to invasion by cancer cells, which gain access to the extramural lymphatics before the deep infiltration of the primary growth has had time to penetrate the muscular coat of the bowel and they should, in all cases, be completely removed when a cancerous rectum is excised.

I have observed plaque deposits in the peritoneum of the pelvic floor upon so many occasions that it would not be an exaggeration to say there is not a portion of it, from the middle line to the brim of the true pelvis, that has not been implicated. This is no doubt due to the fact that the peritoneum in this locality is in close relationship with the extensive lymphatic network situated between the levatores ani and the pelvic fascia. A metastatic deposit in this network, therefore, speedily penetrates the pelvic fascia and extends into the overlying peritoneum. Accordingly, it is essential that the peritoneum of the entire pelvic floor, as far as the brim of the true pelvis on both sides, should be removed in every case of extirpation of the cancerous rectum if immunity from recurrence is hoped for.

3. *The Upward Zone of Spread.* The tissues of this zone are the retrorectal (lowermost mesocolic) glands, the pelvic mesocolon in its entirety, the paracolic glands, the glands situated at the bifurcation of the left common iliac artery and the median lumbar glands.

Since the majority of the efferent lymphatics, which form the intramural lymphatic system, either pass through or terminate in the structures contained in this zone, it follows that these structures constitute the principal paths by which cancer cells spread from primary growths in the rectum. This is the most constant and, therefore, the most important of all the routes of spread. We find either macroscopic or microscopic metastases scattered throughout the zone in practically all cases of cancer of the rectum, even when the growth is in an early stage of development.

In some instances the retrorectal glands are obviously enlarged and can be readily felt, but, in the majority, though the fresh specimen is carefully palpated, it is extremely difficult to be certain whether the glands are enlarged or not. Nevertheless, when these specimens have been hardened and dissected, the involvement of the glands is evident. Moreover, microscopic examination of the glands always shows one or more of them to be invaded by cancer cells. It sometimes happens that a gland may be free from deposit although the tissues surrounding it are definitely invaded by cells. In such a case, if the glands alone were examined and found to be free from invasion, an erroneous con-

clusion as to the absence of extramural spread might be arrived at and a more hopeful prognosis, in regard to the possibility of recurrence taking place in adjacent structures, might be given than would be warranted had a more thorough examination been made.

The pelvic colon throughout its extent is particularly liable to invasion. So often, indeed, is it found to be the seat of metastatic deposit that the removal of the whole of this structure in every operable case of cancer of the rectum is just as important as is thorough clearance of the axilla in an operation for cancer of the breast.

The part of the pelvic mesocolon which is invariably invaded is its parietal border, between the layers of which the superior hemorrhoidal and the inferior mesenteric vessels are situated. The efferent lymphatics from the retrorectal glands accompany these vessels on their way to the glands located at the bifurcation of the left common iliac artery, and constitute the principal route by which cancer cells are carried from the rectum by the blood stream. At any point along this line metastases may occur, either singly or in chains. There is scarcely a part of the pelvic mesocolon in which, from time to time, I have not observed metastatic deposits so that the whole of the structure must be regarded as highly dangerous tissue.

The paracolic glands which are in series with the anorectal glands and are situated along the mesenteric border of the pelvic colon, are often the seat of metastatic deposit. The involvement of these glands does not proceed from one to the other seriatim as might be expected, for a continuous chain of infected glands is never seen. When a paracolic gland is found to be involved, it is generally isolated and may be situated at a considerable distance from the level of the primary growth. Instead of spread taking place from one paracolic gland to another, it is probable that the cancer cells first follow the course of the lymphatics accompanying the inferior mesenteric vessels, and then, owing to blockage of the normal lymph stream by metastatic deposits, grow continuously or are carried by reversed flow along the lymphatic vessels of the pelvic mesocolon towards the colon, to be arrested in one of the paracolic glands.

When, therefore, the rectum, together with part of the pelvic colon, has been removed by a perineal method of excision, it is quite possible that an infected paracolic gland, above the level of the point of section of the bowel, may have been left behind, despite the fact that a careful examination of all the paracolic glands contained in the specimen has failed to demonstrate evidence of infection. Even the extensive removal of the pelvic colon by means of the abdominoperineal operation may sometimes fail to include an infected paracolic gland when situated many inches above the level of the primary growth.

There is ample evidence that the dissemination of cancer cells by means of the extramural lymphatic system is more widespread and of much greater consequence than that which takes place in the intramural lymphatics. Moreover, it appears that, of the three zones of possible extramural spread, the upper zone is the most important because secondary deposits are always present, either visible to the naked eye or discernible by the microscope.

From the above observations it will be seen that the ischiorectal fat, the levator ani muscles, the pelvic peritoneum and the pelvic mesocolon throughout its extent are the tissues which are chiefly concerned in the spread of cancer from the rectum. Pathology teaches us that these structures may be the seat of metastatic deposits even when the growth in the rectum is in a clinically early stage, and that unless these highly dangerous tissues are completely removed in every case in which an operation for the removal of the cancerous rectum is undertaken, postoperative recurrence will be a rule to which there will be few exceptions.

At the close of the year 1906, I abandoned perineal methods of excising the rectum because I found that they failed to prevent recurrence. The type of operation that I then performed was the most complete that it was possible to carry out by a perineal method of exposure. It failed because the tissues of the upward zone of spread which had already been invaded lay beyond the reach of any operation carried out solely from the perineum. These tissues (which would represent the axilla in cases of cancer of the breast) can only be approached from the abdomen, and therefore it is obvious that the attempt to remove the cancerous rectum from the perineum alone is as futile as amputating a breast affected by cancer without also clearing the axilla of its affected lymphatic glands.

Since January, 1907, I have consistently employed the abdominoperineal operation in all suitable cases. I planned this operation in order that the tissues comprising the upward as well as those of the downward and the lateral zones of spread could be widely removed.

Cancer of the rectum claims 100 per cent mortality if left to run its course untreated. If then, the operation undertaken for its cure is followed by a high recurrence rate surgical intervention will have failed in its object.

The operation of choice is the radical abdominoperineal, because it alone of the methods at our disposal ensures thorough removal of the tissues of the three zones of spread. It should be chosen for early cases, on the principle that the most comprehensive operation that it is possible to carry out, for the treatment of the earliest case of cancer, ensures the greatest immunity from recurrence.

The operation should not be recommended for patients who, from age or other reason, are unfitted to stand the strain of a severe surgical ordeal. For these the choice lies between colostomy only and perineal excision as a palliative measure. Should the latter be chosen the most complete perineal excision should be carried out in order to insure that the tissues of the lateral and downward zones of spread are effectively removed. If the latter plan be adopted the possible recurrence will be located in the tissues of the upward zone of spread above the level of the true pelvis and the patient will, in all probability, escape the misery of involvement of the sacral plexus by the growth. For all suitable cases, however, the radical operation should be performed, and preference should not be given to less radical methods purely because they are attended by a lower operative mortality rate. It should be borne in mind that, when dealing surgically with cancer, the utility of an operation should be measured, not by its operative mortality, but by the degree of immunity from recurrence which that particular operation confers.

THE ABDOMINOPERINEAL OPERATION

This is the radical operation for cancer and aims at removal, as completely as possible, of the tissues comprising the three zones of spread. It may be carried out in one stage, namely the one-stage abdominoperineal (the author's) operation, or it may be done in two stages with an interval of ten days or a fortnight between them, namely the two-stage abdominoperineal operation (Coffey's operation).

There appears to be a doubt in the minds of some as to what exactly is meant by a two-stage abdominoperineal operation. I have heard it said that a preliminary colostomy followed after an interval of ten days or so by perineal excision is a two-stage abdominoperineal operation. It is in fact nothing of the sort, because the tissues of the upward zone of spread are left behind. The two-stage abdominoperineal operation is nothing more or less than the one-stage operation performed in two stages with an interval of ten days or so between them.

The first stage ends with the reconstruction of the pelvic floor and the establishment of a terminal colostomy. The isolated portion of the pelvic colon together with the part of the rectum which has been

freed, anteriorly as far as the upper part of the prostate or halfway down the vagina as the case may be, laterally down to the upper surfaces of the levatores ani, and posteriorly down to the sacrococcygeal articulation, is left in situ below the new peritoneal floor of the pelvis. The isolated bowel, having been deprived of the greater part of its blood supply from ligature of the inferior mesenteric artery, necroses and, at the expiration of the interval between the stages, is in an advanced state of decomposition, so that in order to prevent absorption of toxic material a suprapubic gauze-wick drain is provided. Coffey maintained that the mortality of the operation in his hands was considerably reduced by his two-stage method and that by this method the radical abdominoperineal operation has been brought within the compass of the surgeon of average ability.

As the result of my observations upon the paths by which the spread of cancer takes place from the rectum and in consequence of the failure of the most complete operation carried out from the perineum along to prevent recurrence, I planned the radical abdominoperineal operation so as to embrace the tissues of the zone of upward spread in addition to those of the lateral and downward zones.

By this means the whole of the pelvic colon (with the exception of the portion to be utilized for the colostomy), together with the whole of the rectum encased in its sheath of fascia propria; the whole of the pelvic mesocolon; the peritoneum lining the floor as well as the walls of the true pelvis; the whole of the levator ani and coccygeus muscles; the external sphincter muscle; as much as possible of the ischiorectal fat and a wide area of perianal skin, are removed.

Although the operation is comprehensive in its aim, it should not be reserved for advanced cases only. It should be the procedure of choice for early cases; in fact the earlier the better because then we may hope to circumvent the invisible spread of the disease. Should it be reserved for advanced cases only, as advocated by some, then the invisible spread will have advanced beyond the confines of the operation field and recurrence will be inevitable.

The operation is a surgical procedure of the first magnitude and importance, and should not be undertaken unless the patient's general condition is satisfactory. In order to ensure a successful result attention should be paid to (1) preparation of the patient before the operation; (2) choice of anesthesia; and (3) details of after-treatment.

Preparation before Operation. It is most important that a week or ten days be devoted to preparatory treatment. A large number of patients suffering from cancer of the rectum also suffer from intestinal stasis, due in most instances to increasing obstruction to the evacuation of the contents of the colon. In consequence the contents of the colon are often exceedingly septic. Daily purgation and lavage not only empties the colon but reduces sepsis. In those cases in which the growth is situated at the rectosigmoidal junction, the lumen of the bowel may be so narrowed that it is not possible to wash the colon out satisfactorily. Under these circumstances, temporary cecostomy should be performed and the radical operation postponed for two or three weeks. The plan which I have followed for several years and which I have found to be very satisfactory is as follows:

1. If, on examination of the abdomen, there are no signs of intestinal obstruction the patient is given on the morning of admission 1 ounce of a mixture consisting of 2 drams of magnesium sulfate, 1 dram magnesium carbonate, and aqua chloroformi to make 1 ounce, followed at hourly intervals by half an ounce of the same mixture until the bowels act freely. As a rule five or six doses are required. If during this treatment there should develop signs of intestinal obstruction the mixture is discontinued, ½ gr. of morphine is injected hypodermically, and cecostomy is done at once.

2. On each succeeding morning until two days before the radical operation 1 ounce of the mixture is given. A colon washout of 1½ pints of plain water is administered every morning and evening, and 5 gr. of dimol are given twice daily as an intestinal antiseptic. The last dose of the mixture is given on the penultimate morning before the operation and the last washout on the morning before the operation, so that the intestinal canal has complete rest for twenty-four hours. Several hours of sound sleep should be ensured by means of a suitable soporific.

3. During the whole of the preoperative period the patient is kept on a generous nourishing diet until the morning of the operation. He should also be encouraged to take plenty of fluid to drink, to maintain his fluid content.

4. The following investigations should be carried out before the operation: (1) Blood examination including (a) hemoglobin, (b) blood group, (c) blood count, and (d) blood urea; (2) urine examination including (a) twenty-four-hour specimen, (b) catheter specimen, (c) urea concentration test.

Blood Pressure Estimation. Systolic and diastolic pressures are taken while the patient is at rest in bed. I regard it of very great importance that these pressures be accurately taken in order that cardiac energy can be determined by working out the Moots-McKesson "pressure-ratio percentage." This is one of the most valuable tests of operability and should never be omitted. If the pressure-ratio is below 25 per cent the operation will be fatal and if above 75 per cent the risk to life is increased. A cardiac energy index of 50 per cent is the best possible.

A thorough examination in regard to general condition should be made, particularly of the heart and lungs.

The patient should be kept in bed during the whole of the preparatory treatment.

Choice of the Anesthetic. Ether or chloroform anesthesia should never be employed as both these drugs produce a marked fall in blood pressure. So far as my experience goes, the best results are obtained from gas and oxygen anesthesia supplemented by intrathecal percaine (15 c.c. of 1:1,500 solution).

TECHNIQUE OF THE RADICAL ABDOMINOPERINEAL OPERATION

It must be borne in mind that one of the most important factors determining the success of the operation is the rapidity with which the various stages of the procedure are carried out. A definite system of working should be adopted, each step being completed in sequence. In an uncomplicated case the abdominal portion of the operation should be completed in forty-five minutes, and the perineal part in fifteen minutes.

THE ABDOMINAL PORTION OF THE OPERATION

Position of the Patient. Involving as it does an extensive and deep pelvic dissection, the most convenient and the best position for the purpose is the high Trendelenburg. It is important, therefore, to be provided with a good type of operating table. Most hospitals nowadays are equipped with these, but at some nursing homes the tables provided are incapable of giving the high position, and this adds immensely to the difficulties of the operation.

Incision. The best incision is a right paramedian, half an inch from the middle line, extending from the crest of the pubes to a point an inch or more above the umbilicus. The sheath of the right rectus muscle is incised throughout the extent of the skin incision and the muscle displaced outwards. All bleeding points having been secured, the peritoneum is opened in the middle line from one end of the wound to the other. This position of the incision is greatly to be preferred to the one sometimes adopted in the left linea semilunaris, for two reasons: first, because it affords greater facilities for carrying out the pelvic dissec-

tion of the right side; and second, because it permits of the incision for the colostomy being made at some distance from the main incision, so that the latter can be adequately protected from fecal soiling during the subsequent progress of the case.

Exposure of the Pelvic Cavity. A self-retaining abdominal retractor having been placed in position the edges of the wound are widely retracted. Several patterns of these retractors are in use. A rapid survey of the pelvis and the rest of the abdominal cavity is now made with a view to ascertaining whether extramural spread of the disease exists or not. The pelvic mesocolon should be carefully examined for nodules or plaques of growth. The most common positions in which these are to be found are: (a) along the parietal border, in the course of the inferior mesenteric and superior hemorrhoidal vessels; (b) along the margin attached to the colon, where the paracolic lymph glands exist; and (c) in the substance of the mesentery itself, anywhere between these two lines. If even quite minute nodules are discovered in the upper part of the mesocolon, it is direct evidence that widespread extramural extension of the disease has taken place, and the case had better be deemed inoperable. Recurrence is almost certain to ensue higher up in the median chain of the lumbar glands, or in the small intestine as a result of contact.

The failure to find evidence of the visible spread in these situations does not necessarily mean that there is an absence of extramural extension, because such spread may exist in a microscopic state. Even in such a contingency, a wide removal of the mesocolon may succeed in circumventing it. If visible spread exists, however, the widest possible removal may not get beyond the area of upward microscopic extension.

At this stage opportunity may be taken to ascertain the condition of the liver. In my experience, however, there is not much to be gained from this. If there is recognizable disease in the liver there is nearly always obvious extramural disease in the pelvis or in the peritoneum, and if the latter is still in the microscopic stage, then any existing disease in the liver is too small to be recognized, except by post-mortem examination.

The condition of the diseased part of the bowel should next be enquired into. If the growth is situated upon the anterior wall of the bowel, especial attention should be paid to possible involvement of the urinary bladder in the male, or the posterior wall of the vagina in the female. In either of these circumstances the case is in my opinion inoperable. If the bladder is involved it is not possible to remove the growth completely; and if the vagina is implicated the additional operation of removal of the uterus and posterior wall of the vagina entails too great a strain upon the patient's endurance.

Lastly, the peritoneum lining the recto-vesical pouch should be carefully examined for plaques. Very often they are not visible, but can readily be palpated. The existence of plaques and metastases, unless situated near the periphery of the operative field, does not contraindicate an attempt at the radical operation so long as the peritoneum covering them has not been penetrated. If only a small plaque exists, but its peritoneal covering has been penetrated so that the growth is exposed, the outlook is extremely bad because general peritoneal carcinomatosis will probably ensue at an early date.

In the absence of contraindications the operation is performed as follows:

First of all the pelvic cavity is cleared of small intestine. In nearly all cases there is pronounced enteroptosis, the majority of patients being at or beyond middle life. If the patient is taking the anesthetic comfortably, and especially when the abdominal muscles are completely relaxed by spinal anesthesia, the coils of small intestine usually drop out of sight into the upper abdomen; but in some instances this does not happen, and the operator is constantly embarrassed by loops of small intestine being forced down into the pelvis

during deep respiratory movements. Under these circumstances I do not hesitate to pull the small intestine out through the wound and cover it with a warm moist towel. I have resorted to this plan on several occasions, and I can confidently say that I have never seen any harm result therefrom, either from the intestine losing temperature or becoming temporarily congested as a result of its dependent position.

THE PELVIC PORTION OF THE OPERATION

First Stage. The pelvic colon is drawn through the wound and the position of its vessels noted. Occasionally there is some difficulty in doing this because the bowel is adherent to the floor or lateral wall of the pelvis. Except when the colon is the seat of diverticulosis the adhesions are not inflammatory in character but are due to altered peritoneal attachments consequent upon coloptosis. When such adhesions are found they should be freely divided on the outer side of the pelvic mesocolon so as to mobilize the adherent part of the bowel, and thus permit of its being delivered outside the abdomen.

In my earlier cases I was in the habit of dividing the pelvic colon at the seat of election as the first step of the operation. For this purpose a point in the pelvic colon was selected between the areas of distribution of the first and second sigmoidal branches of the inferior mesenteric artery. To this point an intestinal crushing clamp was applied and left on for two or three minutes. For some time past, however, I have left the division of the bowel to the end of the pelvic part of the operation and ligature the inferior mesenteric artery, at the seat of election, before doing anything else. The ligature is applied between the first and second sigmoidal branches.

When the pelvic mesocolon contains little fat the position of these vessels can be seen clearly, and there is no difficulty in applying the ligature at the correct spot; but in obese subjects the vessels cannot be seen. Under these circumstances it is advisable to place the ligature on the inferior mesenteric artery at the level of the bifurcation of the abdominal aorta, as that point is half an inch below the origin of the first sigmoidal branch, and well above the origin of the second branch.

It is never necessary to expose the vessels by dissection, as, by so doing, somewhat free bleeding may ensue from branches of the sigmoidal veins which obscures the view and embarrasses the operator. The simplest way is to transfix the pelvic mesocolon by passing an aneurysm needle behind the inferior mesenteric vessels at the level of the bifurcation of the aorta, and then to ligature the mesocolon en masse. In applying this ligature the position of the left ureter must be borne in mind.

At the level of the bifurcation of the aorta the ureter is from ¾ inch to 1 inch to the left of the inferior mesenteric artery, but at the level of the promontory of the sacrum they are close together, so that if the mesocolon is transfixed too low down, the ureter is in danger of being included.

Ligature of the inferior mesenteric artery, as the first step in the operation, ensures a practically bloodless field during the subsequent steps of the pelvic portion of it and is, therefore, essential. This having been done, a second ligature is placed on the vessels about an inch below the first in order to control venous bleeding from the distal part of the mesocolon when it is divided.

Second Stage. The pelvic mesocolon is divided completely immediately below the first ligature, and then the peritoneum, on either side of the line of origin of the mesocolon, is incised downwards as far as the promontory of the sacrum. When this is being done on the left side, the position of the left ureter should be carefully ascertained lest it be divided or otherwise injured. As soon as the peritoneum has been divided on both sides as far as the promontory, the cellular space, between the anterior surface of the sacrum and the terminal part of the pelvic mesocolon, comes into view.

By thrusting the fingers of the left hand into this space the terminal portion of the pelvic colon and the rectum can be stripped readily from the anterior surface of the sacrum as far as the sacrococcygeal articulation. At the latter point the fascia propria of the rectum is closely adherent to the periosteum of the lower border of the sacrum and cannot be stripped away from it, thus indicating that the level of the articulation has been reached.

Occasionally one or two dense bands of connective tissue extend from the fascia propria to the sacrum. These should be divided with scissors rather than torn from their sacral attachments, lest by so doing a presacral vein be lacerated and give rise to troublesome bleeding. The left hand is now introduced into the presacral space thus opened up and the rectum is pressed forward and upward in order to raise and render prominent the peritoneum lining the floor and the lateral walls of the pelvis. The pelvic peritoneum thus raised is divided forward on either side parallel to the brim of the true pelvis as far as the base of the bladder, care being taken not to injure the ureters which often adhere closely to the peritoneum. These incisions in the peritoneum, along the brim of the true pelvis, are continued until they meet anteriorly behind the base of the bladder in the male, or the upper part of the vagina of the female.

Third Stage. The separation of the anterior wall of the rectum from its connections is next preceeded with. In the male, a well-marked stratum of loose areolar connective tissue exists between the fascia propria of the rectum and the layer of rectovesical fascia which binds the vesiculae seminales to the base of the bladder. When this line of cleavage is found, the separation of the rectum from the vesiculae seminales and the base of the bladder is easily affected, but unless care be exercised the space containing the vesiculae may be opened up, and then the dissection becomes extremely difficult, so that the vesiculae or the vasa deferentia may be injured. It is important that the separation of the rectum anteriorly should extend as far as the upper border of the prostate gland.

Fourth Stage. As soon as the rectum has been freed from its connections both anteriorly and posteriorly down to the points indicated above, the lateral attachments of the rectum can be readily made out. These consist, on either side, of a broad band of dense connective tissue, varying in depth from 2 to 3 inches, which passes forward and outward from the lateral walls of the rectum toward the base of the bladder at the point where the ureters terminate. These bands, the lateral ligaments of the rectum, must be completely divided down to the upper surfaces of the levator ani muscles. The middle hemorrhoidal artery, which passes in the substance of the ligament to its distribution, is always divided but is seldom of sufficient size to need a ligature.

Fifth Stage. The rectum having thus been freed from its connections, anteriorly as far as the upper border of the prostate, posteriorly down to the level of the sacrococcygeal articulation, and laterally to the upper surfaces of the levator ani muscles, the pelvic colon is crushed at the seat of election, that is, at a point situated about 3 inches from the termination of the descending colon. A broad-bladed crushing clamp (author's pattern) is applied to the colon at the point indicated, and then the crushed area is ligatured in two places. The bowel is divided between the ligatures and the ends of the bowel protected by tying a piece of green protective over them. In my earlier cases I invaginated the ends by means of a purse-string suture, but have abandoned the practice in favor of the more speedy method of covering them with green protective.

Sixth Stage. The occluded end of the distal part of the pelvic colon is next pushed down into the presacral space until it rests at the level of the sacrococcygeal articulation, where it can be

easily reached when the perineal portion of the operation is being performed. The remainder of the distal part of the pelvic colon is then crowded down into the cavity of the pelvis and preparations are made for reëstablishing the floor of the pelvis by peritoneum.

Owing to the free removal of the peritoneum lining the floor and the lateral walls of the pelvic cavity, a large gap remains. On no account should the pelvic mesocolon be left in situ with a view to facilitating the closure of the gap, because this structure is largely concerned with the extramural spread of the disease, and is, therefore, to be regarded as highly dangerous tissue.

I cannot emphasize too strongly the necessity of completely removing this structure in every case, together with a wide strip of the adjacent peritoneum, if immunity from recurrence is to be hoped for. The gap cannot be closed by dissecting up the peritoneum from the lateral walls of the pelvis. However much the peritoneum is mobilized at the sides of the gap, the edges can only be approximated posteriorly in front of the promontory of the sacrum and sutured to the stump of the pelvic mesocolon.

The large pear-shaped gap remaining after this has been done can be readily filled in, however, by dissecting up the peritoneum from the base of the bladder in the male, stretching it back across the gap and suturing it there, (or by dissecting up the innermost layers of the broad ligaments in the female and utilizing them to fill up the space.

It is of the utmost importance that the suture line in the new peritoneal floor should be intact. Therefore, when the peritoneum is thin and likely to tear an omental graft should be used to reinforce it.

It will be observed that the new peritoneal floor of the pelvis differs from the normal in that it is situated at a much higher level, that is, at the brim of the true pelvis. Consequently, during the healing process, a new rectovesical pouch is formed, partly by stretching of the peritoneal floor and partly by dragging down the peritoneum of the iliac fossae. On the right side, the terminal ileum is adherent to the peritoneum of the iliac fossa, and therefore a drag upon the peritoneum in this situation may produce a pronounced ileal kink.

Accordingly, as soon as the new peritoneal floor has been completed, any tendency to kinking of the ileum at the point where it enters the cecum should be corrected.

Seventh Stage. The proximal end of the pelvic colon is now utilized for establishing a colostomy. The best position for this is at a point situated 1½ inches internally to the left anterior superior spine of the ilium, along a line extending from that bony prominence to the umbilicus. A short incision, 1½ inches long, is made, the center of which intersects the above-mentioned line at right angles. This incision extends through the skin and subcutaneous tissues only. The aponeurosis of the external oblique muscle is now divided to the extent of 1 inch, and then the muscular fibers of the internal oblique and transversalis muscles are separated in the direction of their fibers by blunt dissection.

An opening just large enough to admit the index finger is made through the transversalis fascia and the peritoneum. Through this small opening the stump of the proximal end of the pelvic colon is drawn, and fixed in position at the upper and lower angles of the wound by means of silkworm gut.

I do not think there is any advantage in bringing the bowel out through the fibers of the left rectus abdominis, as is sometimes advocated in the performance of colostomy. The chief point to be borne in mind is to make the opening just large enough to allow the stump of the bowel to be drawn through it, and no larger, lest herniation of small intestine between the bowel and the edge of the wound should occur.

The abdomen is now closed and a temporary dressing applied. The Trendelenburg position is dispensed with, and the patient is placed in the right dorsal and semiprone posture in order that the perineal portion of the operation may be carried out.

THE PERINEAL PORTION OF THE OPERATION

Incision. The anus having been closed by means of a purse-string suture, a transverse incision about 4 inches in length is made at the level of the sacrococcygeal articulation. From the center of this a longitudinal cut is made in the internatal furrow, and carried down to a point 1 inch from the posterior margin of the anus. From the inferior extremity of this, incisions are carried to the right and to the left of the anus is the shape of a horseshoe, and the anterior extremities of these are joined by a transverse cut. It is important that the arms of the horseshoe should embrace as wide an area of perianal skin as possible, because the skin in this region is especially prone to develop recurrent growth. The gluteal skin-flaps are then reflected and retracted out of the way, thus laying bare the coccyx.

Removal of the Coccyx. The sacrococcygeal joint is opened and the coccyx dissected out. The incisions surrounding the anus are then deepened so as to include as much as possible of the ischiorectal fat. It is never necessary to remove a piece of the sacrum, as ample room is provided by removal of the coccyx alone. In fact, sufficient room for the completion of the operation can be obtained without even removing the coccyx. However, I think it best to remove it, because the coccygeus muscles must be removed and the bone would then be left without any lateral attachments.

Exposure of the Presacral Cavity Containing the Isolated Bowel. A small transverse incision is made into the dense connective tissue immediately below the sacrum, where the attachment of the fascia propria recti can readily be detached from the ventral aspect of the lowermost piece of the sacrum. The index finger is then thrust into this, and, supposing that the separation of the rectum from the front of the sacrum has been carried down to the level advocated above, it readily passes into the space containing the isolated bowel. A transverse incision is then made through the coccygeus muscle on either side, extending outward as far as the great sacrosciatic ligaments. Through the ample opening thus made the isolated bowel is drawn down to its full extent.

When the separation of the anterior connections of the rectum have been carried down to the prostate during the abdominal part of the operation, the base of the bladder and the vesiculae seminales, with the vasa deferentia and the upper part of the prostate, come into view. In the female the uterus and the upper half of the posterior vaginal wall can be plainly seen.

Division of the Levatores Ani Muscles and Severance of the Remaining Connections of the Rectum. By making traction upon the bowel with the left hand the levatores ani are put upon the stretch. If they do not come into view it is because the lateral ligaments of the rectum have not been completely divided from above. In that case considerable difficulty may be experienced in delivering the loosened bowel through the perineal wound, and until the lateral ligaments have been completely severed the levatores cannot be divided. The levatores are now divided at their origin from the lateral wall of the pelvis, the puboprostatic fibers being detached from the prostate.

All that now remains to be done is to dissect away the anterior wall of the anal canal from the tissues forming the central point of the perineum, great care being taken not to wound the membranous portion of the urethra in so doing.

Completion of the Operation. After the removal of the rectum and isolated portion

of the pelvic colon, usually about 16 inches in length, a large cavity is left. This cavity is surrounded by bony structures behind and at the sides, and it is absurd to suppose that it can be sewn up so as to obtain healing by primary intention. The cavity must heal gradually by granulation, portions only of the skin incision being brought together by sutures.

I always pack the cavity with long strips of gauze, to afford support to the new pelvic floor formed only by peritoneum. It is not advisable to allow the gauze to be in direct contact with the walls of the cavity, because it becomes firmly adherent to them and gives considerable trouble and pain to the patient when it is removed.

In one of my earlier cases the peritoneum of the pelvic floor was torn when the gauze was removed, and a coil of small intestine became herniated through the opening. I always use a sheet of green protective, 2 feet square, for lining the cavity, and then pack the gauze into it, the subsequent removal of the guaze thus being rendered easy and painless. Dressings and bandages are then adjusted, and the patient is turned upon his back so that the abdominal wounds may also be dressed. Before the patient leaves the table the ligatures closing the stump of the proximal end of the pelvic colon are removed, and the open end of the bowel is covered with green protective and a pad of gauze.

Postoperative Treatment. Immediately after the operation has been completed a blood transfusion (500 c.c.) should be given, preferably by the drip method. There is no doubt that this is the best means of combating postoperative shock. Immediately afterward, a solution of dextrose saline is given, at the rate of 30 drops to the minute, during the following forty-eight hours, for the purpose of preventing dehydration.

As soon as the patient returns from the theater the foot of the bed is raised and an electric radiant-heat cradle is fitted over him, the temperature being carefully regulated.

No fluid by mouth is allowed during the first forty-eight hours in order to lessen the risk of acute gastric dilatation. Careful watch for the onset of this complication should always be kept and as soon as the subxyphoid depression becomes effaced the stomach should be emptied by passing the stomach tube.

The perineal wound is dressed for the first time seventy-two hours after the operation. After the gauze packing has been removed the cavity is irrigated with (1) hydrogen peroxide (10 vols.) 1 pint, followed by (2) perchloride of mercury (1:500) 1 pint, followed by (3) 2 pints of normal saline solution. Irrigation with these solutions is carried out twice daily during the first week, after which period a solution of iodine or of dettol (2 drams to the pint) is substituted.

On the morning of the fifth day an enema is administered by the colostomy and on the following day a saline purgative is given. The colostomy washout is repeated daily.

At the end of a week the excess of bowel forming the colostomy is removed. Digital dilatation of the colostomy stoma is carried out daily until the tendency to contract, during the healing process, has ceased. The patient is allowed to get up for the first time on the eighteenth day for twenty to thirty minutes.

THE SURGICAL TREATMENT OF CANCER OF THE RECTUM

J. P. LOCKHART-MUMMERY, F.R.C.S. (ENG.), F.A.C.S.

Emeritus Surgeon, St. Mark's Hospital for Diseases of the Bowel

LONDON, ENGLAND

THERE are fashions in surgical procedures just as there are in the design of women's clothes. For a time some particular operation becomes the standard practice in all the important clinics so that it is performed almost to the exclusion of any other method, and then in the course of a few years we find it has been entirely replaced by some other procedure. Often there are good reasons for the change-over, but I am inclined to think that this is not always the case and that some particular operative procedure is liable to be adopted just because it is the fashion and not as the result of a careful study of the end results.

I have been in practice long enough to have seen many such changes; some have been definitely advantageous, but I am not so sure of others. As an example we may take the operation for gallstones. Some years ago the standard practice was to drain the gall-bladder, cholecystotomy, while today the operation that is almost exclusively performed is removal of the gall-bladder, cholecystectomy. Now the end results of cholecystotomy were often very satisfactory and I have a suspicion that today many patients with gallstones would be better if they had their gall-bladders drained rather than removed.

Then again, gastroenterostomy was a most satisfactory operation, which has been entirely replaced by gastrectomy. There also I am not sure that the change is entirely beneficial. We are beginning to see cases of anemia following gastrectomy.

We come back to the fact that the wisest course is to fit the operation to the patient and not the patient to the operation. Some cases that are now treated by cholecystectomy would do better if their gall-bladders were drained, and some patients now treated by gastrectomy would do better if treated by gastroenterostomy. We should not allow ourselves to become stereotyped in thinking that there is only one operation for the treatment of all cases of a particular disease. We should study the particular case and perform that operation which in our judgment will be the safest and will be most likely to restore the patient to perfect health, and should not allow ourselves to be prejudiced into performing some particular operation just because it happens to be the fashionable one at the time.

This applies also to operations for cancer of the rectum. We have in the last twenty-five years seen many changes in the standard operations performed for this disease. There is my two-stage perineal excision; there is the Miles technique for performing a one-stage abdominoperineal excision; there is the modification of perineo-abdominal excision in one or two stages; and lately various methods, mostly revivals of old methods, for local excision and restoration of the rectum.

I propose here to discuss the pros and cons of these operations, so as to assist the young surgeon in coming to a decision when he is called upon to deal with a case of cancer of the rectum. I would like again to stress the fact that there is no one method which is applicable to all cases and that no surgeon should aim at one standard practice. While it may pile up his own statistics it will be at the expense of his patients and his own results will not be so good as those of the surgeon who uses the technique most suitable for the individual case.

Although the method of excising the rectum by the perineal route, which goes by my name, has now become the standard practice for suitable cases of cancer of the rectum, I have never suggested that it is the only method of removing the rectum,

or that it should be practiced to the exclusion of other methods. I have, it is true, used the perineal two-stage method of excising the rectum in most of the cases that I have treated, but when another method seemed for some reason or another better suited to the particular case I have always adopted that method which seemed to me to give the patient the best chance.

Let me start by saying that the ideal operation for removing the rectum for cancer has not yet been devised, and it is possible that it never will be as there are so many conflicting difficulties.

It is obvious that no method can be ideal which leaves the patient with a permanent colostomy. Numerous attempts have been made, both by myself and others, to find a technique that will allow of the removal of the growth and yet leave the patient with a normally functioning bowel. Many of these methods have been quite successful in that the restoration of the rectum has been achieved, and I have several patients alive and well with a normally functioning rectum from whom I removed a rectal carcinoma many years ago. But the method has been discarded except in a very few cases of early growths of a low malignancy (Grade 1, Broder's) owing to the frequency of recurrence in cases so treated. Were it possible to be certain previous to operation that the tumor has not spread beyond the rectal wall, this method would be justifiable, but at present there is no means of selecting suitable cases with any certainty. In other words, much earlier and more accurate diagnosis is necessary before local resection of rectal growths can be successfully practiced.

When the surgeon is called upon to treat a case of carcinoma of the rectum there are several factors that he has to take into consideration before deciding upon the particular method which will give the best result for his patient:

1. He must be as sure as possible that his operation will entirely eradicate the disease and, as far as may be, do away with the chance of recurrence. This is the first consideration because without it the operation is doomed to failure and might as well not be done at all.

2. The operation must be reasonably safe and, so far as other considerations make this possible, give the patient the maximum chance of survival.

3. When the patient is old, feeble, or the subject of some other disease or disability, if an operation is decided on one must be chosen which will give a reasonable chance of survival. The more drastic procedures are ruled out.

4. In a young person (50 or under) that operation should be chosen which will give the best chance of completely eradicating the disease, since the younger the patient the greater is the risk that the tumor has already spread to the lymphatics and other tissues.

The surgeon should not choose any particular operative procedure just because other people advocate it or because he has seen it done in famous clinics or because it seems the easiest method. He should study the actual facts as regards operative mortality and especially recurrence rates, which are now available about all the well established operations for rectal cancer. He may then choose that one which seems to be most suitable for the particular case he has to treat.

Let us consider some of the advantages and disadvantages of the various standard operations as now performed for rectal cancer.

THE PERINEAL EXCISION IN TWO STAGES

This method is suitable in any case where the tumor is confined to the rectum proper and where the examining finger can reach to or above its upper limits. The first stage consists in exploring the abdominal cavity to make sure that there is no involvement of the liver and that the growth has not spread into the abdominal glands or involved the peritoneum, and in establishing the colostomy opening.

Since the colostomy is to be permanent, some care should be taken in making it as

satisfactory as possible. There should be a complete bridge of skin and abdominal wall between the two openings of the colon, as this will prevent any possibility of fecal matter finding its way into the lower blind opening and will also militate against the subsequent formation of a ventral hernia at the site of the colostomy.

From a week to a fortnight should be allowed to elapse between the first stage and the second for the removal of the rectum. This will enable the abdominal wound to heal and the bowel between the colostomy and the anus to be thoroughly washed out and cleansed. It will also give time to get the patient's bowels properly regulated: a very important point since most patients with a growth in the rectum are suffering from some degree of intestinal stasis.

At the second stage the entire rectum and anus are removed by the perineal route. A description of the actual technique will not be given here as it can be found in most of the standard textbooks. (A full description appeared recently in *Surgery, Gynecology and Obstetrics*, Nov., 1938.) This second stage can be very rapidly performed unless some special difficulty presents itself, the time varying from twenty-five minutes in an ordinary case to fifty minutes in a very difficult one, in the hands of a skilled surgeon.

The mortality is the lowest of any method for excising the rectum. The lowest operative death rate in the author's hands was 4 per cent for 150 cases which compares very favorably with an operation upon patients of equivalent average age.

A low operative mortality is of little value unless it is accompanied by a low rate of recurrence as shown by a careful follow-up extending over many years. Over 500 cases treated by this operation have now been studied and show a five-year cure rate of over 55 per cent. This is at least as good as for any other of the standard operations for cancer of the rectum, and has established this method as the best so far for those cases to which it is suited.

There are very many cases of cancer of the rectum where the patient is a bad surgical risk either because of age, infirmity, or accompanying disease, and in such cases if there is a reasonable chance of eradicating the growth completely by this method it should be preferred. It is often possible by this method to cure a patient of cancer, who would have little chance of survival if treated by a combined route.

The disadvantages of this operation are that it is not suitable where the growth is situated high up or is at the rectosigmoid junction, or where the tumor is very large and is filling up a large part of the posterior pelvice space. It is also not at all an easy operation to perform, though with practice it is not unreasonably difficult.

It can quite easily be performed in one stage, the colostomy being done first and the abdomen explored, then the patient is turned over and the rectum removed. In elderly subjects or bad risks, it is, however, safer to perform it in two stages.

THE COMBINED ROUTE

It was the practice until the last few years to make use of the combined abdominoperineal route in all cases where the tumor was situated too high up in the rectum for removal by the perineal route, and in cases where there was reason to doubt the possibility of completely eradicating the disease by the latter method. Today the abdominoperineal route is seldom, if ever, used, at any rate in St. Mark's Hospital, as it has given place to the perineo-abdominal route.

The advantages of perineo-abdominal approach are that the operation is much more easily performed and is quite appreciably quicker. The closure of the peritoneal floor from the abdomen after the complete removal of the bowel and tumor is quite a simple procedure, whereas in the abdomino-perineal operation where the peritoneum has to be stitched up over a mass of bowel and tumor pushed down into the posterior pelvis, it is often quite difficult.

The whole operation has been completed in fifty-six minutes, or, with two surgeons working at the same time, in forty minutes. I feel sure that the perineo-abdominal operation will entirely replace the older abdominoperineal method.

The operation may be performed either as a one-stage or two-stage operation. If performed in one stage, the abdomen is first opened by a midline incision and explored, then the wound is temporarily closed and covered over. The patient is turned over into the left semi-prone position. The operator now dissects the rectum free by the same procedure as if he were going to perform a perineal excision. When the peritoneum has been opened from below and the lateral fascial attachments have been divided, a glove or rubber bag is drawn over the rectum and it is pushed up into the depths of the wound. A piece of rubber sheeting is then placed in the wound and inside this a strip of gauze packing is placed, the ends of the rubber and packing being brought out as a drain and the skin closed tightly round. The patient is then turned on the back again, the abdominal wound reopened, and the rectum pulled out of the pelvis. The peritoneum is divided on each side of the mesocolon and the main vessels ligatured. The gap in the peritoneal floor is now closed with stitches: the bowel is brought out through a separate wound in the abdominal wall on the left side, or through the upper part of the main wound, and the abdominal wound is closed in the usual way. Last of all the colon is divided an inch away from the skin between clamps. This completes the operation.

The objections to this method are that it necessitates turning the patient over into a new position twice during the operation. This not only wastes time—at least fifteen minutes—but it causes a certain degree of shock and disturbance of the circulation.

Recently attempts have been made to get over this difficulty by putting the patient before operation into a special —Trendelenburg—lithotomy position by means of special thigh pieces attached to the table. This enables the surgeon to perform the whole operation without disturbance of the patient or towels. A full description of the technique was given by Mr. O. V. Lloyd-Davies in the *Lancet* (July 8, 1939). This position saves a great deal of time and with two surgeons working at the same time the whole operation has been completed in forty minutes.

A one-stage perineo-abdominal operation should never, or at least very rarely, be performed without first making an abdominal incision to ascertain whether there are metastatic deposits in the liver or elsewhere. It is rather tempting to perform the operation without this exploratory incision, but if this is done there is a grave danger that the patient may have been subjected to a serious operation which has no hope of being curative.

This form of combined perineo-abdominal recestion, which was first described by Mr. W. B. Gabriel, has, it seems to me, great advantages over the abdominoperineal method, and the disadvantage of having to move the patient twice can be entirely done away with if the new Trendelenburg-lithotomy position is made use of. The operation is easier, quicker and safer. It also has the advantage that if during the performance of a perineal excision the surgeon finds that the operation will not give him a sufficiently wide removal of the tumor, or that he is in difficulties owing to the tumor being larger and more inaccessible than he expected, he can turn it into a combined operation by finishing in the abdomen.

THE ADVANTAGES OF A TWO-STAGE OPERATION

I have always felt that in many cases requiring removal of the rectum it is advisable to do a two-stage rather than a one-stage operation. Many of the patients are partly obstructed and are suffering from toxemia owing to the fact that the growth is causing serious narrowing of the bowel lumen, or because it is preventing by

its presence satisfactory evacuations. It is often not possible to clear the bowel out satisfactorily, and if this is so, and it is not infrequently the case, the patient is not in good condition to stand up to such a serious operation as complete removal of the rectum. One has only to observe the very improvement which takes place in such patients after a preliminary colostomy to be convinced of the advantages of performing the operation in two stages.

Surgeons as a whole have been so impressed with the advantage of doing a decompressing operation first (if I may use the term) especially in the case of old or feeble subjects, that a preliminary colostomy, either temporary or permanent, is now the usual practice for all operations for carcinoma of the large bowel.

For this reason it has become the usual practice to perform perineal excision of the rectum in two stages. If a two-stage operation is advantageous in performing perineal excision then it should be even more advantageous when performing the more severe combined operation.

There are, however, certain difficulties about doing the combined operation in two stages, which have so far not been entirely got over. The objection that a colostomy opening on the abdominal wall renders it difficult to keep the laparotomy wound free from infection is not serious, as the wound can be completely protected by rubber sheeting stuck to the skin with mastic and by towels clipped to the skin edges. With proper technique the surgeon should have no anxiety about the infection of the laparotomy wound owing to the presence in the neighborhood of the colostomy opening.

The real objection is that so far surgeons have not discovered a satisfactory means of dealing with the section of bowel between the colostomy opening and the rectum. The obvious method of dividing the colon, bringing the upper end out as a terminal colostomy and sewing over the lower end and dropping it into the pelvis, has proved unsatisfactory. No matter how carefully this is done, it is invariably discovered when the rectum is removed that this blind end of the colon has formed tiresome adhesions to some contiguous structure with resultant waste of time in freeing the adhesions and often serious risk of infecting the wound.

An alternative method suggested by Lahey of leaving the lower end of the colon open to the surface and dissecting it out before again opening the abdomen has also not proved satisfactory, as adhesions form around the sides of the blind bowel inside the abdomen.

My own practice has been to perform the original colostomy in continuity, which allows the rectum to be thoroughly washed out from above, and at the end of the second stage to divide the colon as close to the inside of the abdominal wall as possible. This method works fairly satisfactorily, but although I always cover over the turned in end of the colon with omentum or fat, I have had trouble in some cases from sepsis in the blind stump. The ideal method would be to dissect out the stump of blind colon at the end of the operation instead of leaving it in place, but this involves the expenditure of valuable time and the risk of infection from the colostomy opening.

It must be admitted that so far a satisfactory solution of this little problem still awaits discovery, and in the meantime most surgeons, unless the condition of the patient obliges them to do a preliminary decompressing operation, prefer to perform the whole operation in one stage.

There is still plenty of room for improvement in the surgical treatment of cancer of the rectum, but it must always be remembered that the patients are as a rule elderly and that no operation which is accompanied by a high mortality rate is justifiable, since well tried methods with a reasonably low mortality rate can be used. In a long series of cases these have proved satisfactory from the point of view of five years' freedom from recurrence.

OPERABILITY AND TYPES OF SURGERY IN CANCER OF THE RECTUM

THOMAS E. JONES, M.D.

Cleveland Clinic

CLEVELAND, OHIO

OPERABILITY statistics on carcinoma of the rectum are at great variance, being quoted in the literature at from 25 to 75 per cent but, unfortunately, when figures are quoted, the manner in which they are arrived at is not stated and the reader is confused. Many of the statistics are presented by able surgeons of equal capabilities and the wide difference can only be explained by the fact that figures are arrived at by entirely different methods of analyzing groups of cases. For instance, the patient is advised to have an operation but does not return. Where should that case be classified if examination revealed it to be favorable for operation? Another instance is where the surgeon is called in consultation when the patient is in extremis. Where should this be included in the statistical study? It seems to me that a simple method of computing our statistics could be used so that series of cases could be compared on an equal basis.

I thought it might be of interest to take a series of 100 consecutive cases as they came in for examination and follow them through to find out exactly what happened in each individual case. In the table below are listed 100 consecutive cases as they appeared for examination with primary, untreated carcinoma of the rectum.

TABLE 1

A. Patients examined		100
B. Radical operation advised, did not return		10
Balance		90
C. Operation not advised, too far advanced	11	
Palliative procedure advised	9	20
D. Operated upon for cure		70
E. Inoperable at exploration		
Liver involved	10	
Local fixation	3	13
F. Operation completed		57

It can be seen from a glance at this table that operability percentage can be figured in many different ways. There were fifty-seven completed operations and the percentage can be figured on a basis of 100, or ninety, or seventy, or, as a matter of fact, from a standpoint of local extension, on the figure of sixty. These operability percentages, therefore, could vary from 57 per cent to 97 per cent. It is also seen from the table that ten patients who were considered clinically operable did not return for treatment for various reasons, namely, distance from home, objection to colostomy, or desiring another hospital or surgeon. I myself think that the operability percentage should be computed on the basis of ninety.

As is shown in Group c there were twenty cases which were considered inoperable. Here again one could roughly estimate that the operability was 80 per cent, but it is not a true picture of the series of cases. Therefore, there remained seventy cases which were considered clinically operable and which were sent to the hospital, radical operation being the advised treatment. However, at operation it was found that the liver was involved in ten cases, and it was impossible to remove the growth in three cases on account of local fixation. Therefore, out of the seventy cases, there were fifty-seven completed operations. Here again, one may say that his operability was fifty-seven out of seventy cases, or 81.4 per cent. This also does not give a true picture because it eliminates twenty cases which were clinically inoperable due to various reasons.

It is quite apparent, then, why operability figures vary. For purposes of comparison, therefore, operability figures should be

reported both in relation to the total number of cases seen and those cases in which operation was advised, and also in relation to the number of cases which had exploratory operations.

In this group of 100 consecutive cases, the types of operations performed in fifty-seven are as follows:

	Cases
Combined abdominoperineal resection in one stage	54
Colostomy with posterior resection	1
Colostomy with segmental resection	1
Electrocoagulation	1
Mortality: 4—Based on 56 major procedures, equals 7.2 per cent	

A variety of procedures and different techniques for the same operation have been handed down over the years. In fact, there are far too many to go into detail, but in the final analysis, the controversy lay over the selection of a perineal anus or an abdominal colostomy. Both have their advocates and the procedure of choice is generally based on previous training and experience. Eventually, if we can secure an accurately controlled group of cases for comparison, the procedure which will win out will be the one that offers the highest rate of curability.

My earliest recollection of the various types of operations is of the simple posterior excision without exploration or colostomy. The operability was low, the mortality rate high, and curability rate not good. I think that the only occasion for employing this type of operation is in elderly people with anorectal cancer—a very small group of cases. Here the spread is to the inguinal glands and exploration may be dispensed with if it adds materially to the risk.

In this country, colostomy and posterior resection in two stages enjoyed considerable popularity for many years. While I have not had a great deal of experience with it, those who have had are abandoning it as a routine procedure because experience has again shown that the rate of curability may be improved upon by more radical measures. This fact was quite apparent to me years ago; therefore, I could not become enthusiastic about it.

In order to preserve the sphincteric apparatus, the Kraske approach and segmental resection with anastomosis posteriorly has been sporadically used, but it is mentioned only to be condemned as any type of operation for eradication of cancer. In instances where it has been successful, the tumor was limited to the mucosa and in such cases I believe it could have been cured by much simpler means, namely, electrocoagulation or implantation of radium seeds as we have demonstrated in a small group of cases. Here again, however, of the total number seen, the percentage limited to the mucosa is very small. It is to be hoped that we would see all of these cases when they were limited to the mucosa where simpler procedures would give even a higher rate of curability than we are now able to obtain by radical procedures.

I am still of the conviction that the abdominoperineal resection (Miles operation) offers the best chance of cure, or a longer period of immunity from recurrence. Personally, I am unable to reach the bifurcation of the aorta by any posterior approach and, when doing the abdominoperineal operation, this is usually the starting point in the removal of all vulnerable areas of spread. In our present day knowledge of cancer it is unreasonable to assume that an operation smaller in scope will give as high a percentage of cure as the abdominoperineal resection. This operation may be done in one or two stages; however, one must use the type of operation with which he is most familiar and which the facilities at hand permit. My preference has always been the one-stage operation, the technique of which has been described previously.[1] The two-stage procedure is resorted to only in cases where there is an obstruction which cannot be relieved by routine medical management for a week before operation. This preoperative treatment, I am sure, is one of the greatest factors which has resulted in a low opera-

tive mortality. We must also bear in mind that when two major procedures are performed on a patient, the possibility of accidental death is doubly increased, so it is not necessarily a safer procedure. Then again, after the first stage has been done complications sometimes arise which may indefinitely postpone the completion of the second stage.

This operation has been reversed, making it a perineal-abdominal procedure, the perineal portion being done first and the abdominal part second. However, this necessitates a previous laparotomy to investigate for metastases, and this operation is therefore really an abdomino-perineo-abdominal-perineal operation, the last maneuver being the packing of the posterior cavity. Bartlett and Rankin in this country and Gabriel in London have had some experience with this procedure, but to me it seems to involve more work than is necessary in order to accomplish the same thing.

Palliative Treatment. While I am a staunch advocate of the colostomy, there is a certain group in which I think it is not indicated. As will be seen in column C, Table 1, palliative operation was not advised in eleven cases because it was thought that it would not materially add to the comfort of the patient. The pain of obstruction must be distinguished from the pain of extension. If there is no obstruction, we are merely adding to the patient's discomfort by giving him a colostomy because it does not necessarily remove one of the greatest complications, namely, frequency and urgency of stool. The ulceration accounts for the frequent emissions of pus, mucus, and blood, and the colostomy will not prevent this. Therefore, the patient has two nuisances instead of one.

CONCLUSIONS

It seems to me that the simple table presented in this article would be of value in reporting operability statistics. At a glance one could then compare the figures given with his own.

With regard to the type of operation, I think that the abdominoperineal resection offers the best chance of cure in any case where it can be carried out.

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CHOICE OF OPERATIVE PROCEDURE FOR CARCINOMA OF THE RECTUM*

A. STEPHENS GRAHAM, M.D.

Assistant Professor of Surgery, Medical College of Virginia

RICHMOND, VIRGINIA

A DECIDED majority of those who are interested in the treatment of patients with carcinoma of the rectum, including surgeons, internists and radiologists, consider surgery the treatment of election in most of the cases that are operable. It is not within the scope of this presentation to discuss the relative merits of surgery and radiotherapy. Cade,[1] a few years ago, probably expressed the opinion of most surgeons when he stated: "At the present stage of radium therapy it must be admitted that for cancer of the rectum and colon, a correct surgical excision gives the patient as good a chance of cure as can be hoped for. As, however, a similar statement was true for cases of buccal cancer about six or eight years ago, it is not unreasonable to believe that with advancement of knowledge and with improved technique the position may be altered within the next few years." Very definite progress is being made in the field of radiotherapy as applied to cancer of the rectum; however, until remedial agents than surgery offer more favorable expectations of cure or palliation it is my opinion that resection clearly is justifiable in all cases up to and frequently including those of borderline operability. Extirpations for the latter group, however, are often formidable and require not only a certain measure of skill but considerable courage.

A case which is considered operable by one surgeon may be considered inoperable by another. The surgeon who is satisfied with an operability of 25 per cent may do posterior resection or even local excision with low mortality and a high percentage of patients who survive for three to five years, but by so doing he abandons another 25 per cent or more of those patients whose condition might be operable in the hands of a surgeon who is bolder and does a more radical resection. Moreover, the latter will have a much larger number of five-year survivals in a given number of patients originally examined and on whom a diagnosis of carcinoma was made.

Save for the small group of patients who present themselves with acute intestinal obstruction, carcinoma of the large intestine may be considered, insofar as its surgical treatment is concerned, as a chronic disease. This is of foremost significance in that it allows time in which to institute preliminary medical measures aimed at increasing factors of safety in the extirpation of these lesions. Chronic obstruction of the large intestine deserves careful consideration because of the accompanying rapid debilitation and desiccation. Prolonged absorption of the septic contents of the colon through its damaged mucosa and that of the terminal ileum causes a lowered physiologic state which has a direct bearing on the outcome of any type of operation. Peritonitis, bronchopneumonia and other postoperative complications which result even from simple operative procedures instituted for relief of obstruction or for palliation are probably directly the result of intoxication due to obstruction.

If the obstruction is acute, which has been quite infrequent in my experience, or of the chronic type which has failed to respond adequately to the usual medical measures of decompression, drainage by cecostomy or colostomy proximal to the

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growth is urgently indicated as a preliminary step to subsequent resection. While this is now a well recognized surgical principle and is more or less the general practice, many surgeons continue to explore the abdomen at this time; relief of the immediate obstruction is the paramount consideration and manipulation of the colon under such circumstances is highly dangerous due to the likelihood of perforation or of spread of organisms which may have penetrated the distended, attenuated wall of the colon. Although I recognize the tremendous advantage of preliminary cecostomy or colostomy as an adjunct to surgery of the left half of the colon and rectum and believe that its employment is invariably demanded in the following instances: (1) acute obstruction, (2) chronic obstruction unrelieved by medical measures, and (3) resection of the rectosigmoid followed by immediate anastomosis, I do not consider such a step essential to safe surgery of the rectum when obstruction is absent or has been adequately relieved. The proof of this to me has been the practical experience with a goodly number of cases observed in my own practice and that of former associates in which incomplete obstruction, often to a marked degree, was relieved by a régime consisting of initial purgation, repeated colonic irrigations, and an essentially non-residue diet. Strict avoidance of oral administration of barium in conjunction with roentgenoscopic examination of the intestinal tract when an obstructive lesion of the colon is suspected will, I believe, reduce materially the necessity of preliminary procedures for drainage, for unquestionably such practice is responsible for many instances of acute obstruction superimposed upon chronic obstruction of long standing. Adequate care in preparing these patients for operation, taking five to seven days or more, is, in my opinion, secondary in importance only to early recognition of the malignancy.

Emergency surgery is rarely necessary or justifiable in such cases, since obstruction, when it develops, usually is slowly progressive and well tolerated even for a week or more after it becomes complete. The blood chemistry under the circumstances, in striking contrast to the findings in acute obstruction of the small intestine, may and usually does remain unaltered. On a number of occasions, in consultation with other surgeons or on visits to their hospitals, I have observed the tendency to consider as acute obstruction cases which in my experience have, in most instances, responded to a medical régime aimed at decompressing the chronically obstructed bowel. Even if the response has not been wholly adequate there can be no doubt that the patient becomes a better operative risk for cecostomy or colostomy after a period of hospitalization in which measures to overcome dehydration have been instituted. The discrepancy in statistical reports on the incidence of acute obstruction may be explained in part by a difference in the interpretation of that which constitutes an acutely obstructed colon.

In regard to standardization of technical procedures employed in the treatment of carcinoma of the rectum Cheever[2] has said: "Even were it desirable, it certainly is not possible completely to standardize the treatment of any disease. Such a multiplicity of variable factors is involved, in the patient himself, in his disease, in therapeutic measures, and in the physician who applies them, that any attempt at actual standardization is fallacious and unlikely to prepare the physician to meet an unusual and unforeseen situation when it arises. Nevertheless a classification of the types of a disease and a knowledge based on experience of what measures have proved best to meet each typical condition are absolutely essential to prompt and efficient action. Of no disease are these statements more true than of carcinoma of the colon, and yet, in the selection of operative measures in this condition very great divergence of opinion exists among surgeons of experience as to what methods are best."

Although standardization of surgical procedures is not wholly practical I feel with Daniel Fisk Jones[3] that at least some agreement as to the fundamental principles of the treatment of patients with carcinoma of the rectum can be reached. In a valuable contribution to the subject he quoted Grey Turner as having said: "The history of surgery of malignant disease is neither so discouraging nor so discreditable as many would have us believe, for it shows that when efforts of the surgeons have been *sufficiently thorough*, the results have often been commensurate with the sacrifice which the patient has had to make." The fundamental principle to be settled is: What is a "sufficiently thorough" operation?

This has been answered up to the present by two opposing groups. The first group contends that carcinoma of the rectum metastasizes late, and consequently that local operation is sufficient. The other group accepts the postulate that all carcinoma which can be extirpated should be dealt with radically not alone by its removal but by removal of the contiguous gland-bearing tissue as well. In 1912, Paul[4] of Liverpool, whose exteriorization measure for colonic lesions is a landmark in intestinal surgery, said: "Why should we undertake an extensive excision of the mesentery for the removal of glands which in all probability are not infected?" Similarly certain surgeons today contend that local or essentially local excision of the rectum, with or without preservation of the perineal anus, is "sufficiently thorough." The description of the pathologic anatomy of carcinoma of the rectum and rectosigmoid by Miles constitutes one of the classics of modern surgical literature and has profoundly impressed a great majority of English-speaking surgeons, and more recently certain French and Scandinavian surgeons. There is still a small group, however, which clings to the belief that local excision is adequate in all cases. I again quote D. F. Jones:[3] "The implication that a local or restricted operation gives as good results as an extensive operation because a surgeon here and there has had a patient live five years or more after a local or restricted operation is without foundation in fact. Before statements about the value of any operation are made, we must know the type of growth and extent of local disease, the percentage of cases operated upon, the mortality and the number of patients living in comfort three, five, or more years. These reports of small series of cases treated by local or restricted operation without stating the percentage they are of the total number seen are discouraging to those trying to improve results and to operate upon a large percentage of cases, and it makes it difficult to do any operation other than the limited ones reported because physicians and patients hear of them and will not submit to the more extensive and, I believe, better operations in most cases." Jones further states that he had met one man who was at least honest in the matter. He admitted that he amputated the rectum by the posterior route because his mortality was lower than with the more extensive operation and, as the mortality was lower, a better impression was made on the community even though the late results were not so good.

The controversy as to what is a "sufficiently thorough" operation for carcinoma of the rectum is continued to a great extent by those who object to permanent colostomy. A fairly considerable number of physicians still object to colostomy on general principles, but among those surgeons who are particularly interested in the treatment of carcinoma of the large intestine there are very few in this country and England who do not consider permanent abdominal anus essential to any surgical procedure directed toward the cure of carcinoma of the rectum and rectosigmoid. Babcock,[5] however, in 1934, stated: "It is our feeling that colostomy should now be eliminated except as a palliative measure. Not only is the perineal opening convenient to take care of but it enables the surgeon, by digital examination, to locate and

remove a pelvic recurrence at an early stage." Horsley,[6] in 1937, in describing a technique of restoring the continuity of the bowel after resection of the rectosigmoid wrote: "Something more than mere existence should be included in the objective of surgery. If the patient can be made more comfortable and life is made to seem more worthwhile after a procedure that offers about equal chances of a cure of the cancer as other operation, it is obvious that this technique should be adopted." Pfeiffer,[7] in discussing a recent paper which described a procedure for restoration of the contunity of the bowel after resection of the rectosigmoid, had this to say: "It has been the dream of every surgeon interested in the surgery of malignant disease of the rectum and rectosigmoid to devise a plan which fulfills the requirements of adequate cancer surgery and at the same time permits restoration of continuity of the bowel. No artificial anus is equal to the natural mechanism. I am, however, impelled to interpolate right here that a well made and properly located colostomy in a well patient is easily managed. The chief and most vociferous objectors to colostomy are those who do not have them and do not need them to remain alive.

"It is to be hoped that no one will advocate or condone deliberate sacrifice of sound cancer surgery for any lesser consideration. Good surgery cannot be founded upon the occasional lucky case or the unusual condition. The lowest mortalities, the highest operability rates, the greatest percentages of cures are unquestionably in the hands of those whose practice it is to perform the widest removal of tissues.

"In my earlier experiences with carcinoma of the rectum and rectosigmoid I tried a number of expedients to restore continuity, but my results were such that I felt that the occasional successes did not counterbalance the increased morbidity and mortality, as contrasted with frank adoption of permanent colostomy in all but highly selected cases. Of course, the uncontrolled perineal colostomy is infinitely inferior to the abdominal anus in all respects except sentimental nonsense."

Lee,[8] in discussing the same procedure, emphasized "that in our experience the patient's adaptation to a life with an artificial anus is not so difficult as is generally supposed, and that when properly made and properly cared for, which means the discarding of the filthy colostomy bag, it is possible to carry on a normal life without embarrassment to one's family or friends. I recall one patient in particular, a woman of unusual refinement, who for more than three years has been attending to all of her social duties just the same as she did before operation, and indeed as far more active than most of her friends of her age, and no one is conscious that she is carrying on with such a handicap."

With Pfeiffer and Lee I find myself in full agreement. It is my conviction, after personal contact and correspondence with many patients and their physicians in regard to their attitude toward colostomy that the average patient not only finds permanent colostomy tolerable but fully commensurate with a comfortable and useful existence. Recent contact with fifty of these patients permitted the following brief survey of their manner of living following the establishment of a colostomy: actively engaged in gainful pursuits, twenty-four; actively engaged in fraternal, church or social activities, but retired from regular work because of financial independence, nine; housewives undertaking their duties without assistance, seven; employment desired but so far not obtainable, seven. Only three considered colostomy such a handicap that they avoided both employment and social activities; six found it necessary to forego both because of debility incident to recurrence but they had been actively employed for periods ranging from five to twenty-two months. Two of these were inoperable at the time colostomy was established and one, a college professor conducted his regular

course for six months and made five out-of-town addresses before retiring.

COMBINED ABDOMINOPERINEAL AND PERINEO-ABDOMINAL RESECTION IN ONE STAGE

In my opinion a radical combined operation in a single stage is the preferable procedure. The local growth and its contiguous gland-bearing tissue are extirpated en masse after the manner of Miles,[9] or following some modification, such as the perineo-abdominal excision of Turner, Gabriel, or Rankin. More familiarity with technical details and more meticulous preoperative preparation and postoperative care have permitted Miles, Abel, Rankin, T. E. Jones and others in recent years to utalize the single-stage procedure in a much higher percentage of cases than hitherto. Abel,[10] of London, lists three fundamental principles of surgery involved in operating on a patient with carcinoma of the rectum and states that the only operation which fulfills these principles is the radical abdominoperineal excision introduced in 1907 by Miles: (1) Not only the growth but also all removable fields of lymphatic spread must be extirpated as widely as possible; (2) the abdominal, or aseptic field, should be dealt with before the relatively infected perineal area; and (3) before a primary growth is manipulated in any way, the blood and lymph vessels which are liable to transmit metastatic cells into the venous and lymphatic circulations should be ligated, and dissection be carried out as far as possible from the original lesion. Posterior excision following colostomy will not fulfill any of these requirements. Perineo-abdominal excision will fulfill only the first principle, since the initial approach is through the relatively infected perineal region and the segment containing the growth is manipulated prior to ligation of the blood and lymph vessels.

Gabriel,[11] who is the principal advocate of the one-stage perineo-abdominal operation, takes a somewhat different view from that of Miles and Abel. Admitting the merits of the abdominoperineal excision he states that the considerable number of two-stage modifications which have been described indicates the desire and the attempts of surgeons to minimize the risks of the original operation. He enumerates the following advantages which the one-stage perineo-abdominal excision possesses over the operation of Miles: (1) it is an easier operation to perform provided the operator has the experience which enables him to do a neat perineal dissection; (2) it overcomes the serious difficulties of a narrow male pelvis, especially in those cases with a large tumor at the rectosigmoid juncture; (3) the dangers of sepsis and shock are largely eliminated—the former by avoiding intraperitoneal division of the colon, and the latter by doing the perineal part of the operation first so that no turning of the patient is required after completion of the abdominal operations; and (4) it fulfills all the requirements of a radical operation in regard to high sections of the vascular and lymphatic pedicle and, in regard to the length of bowel which is removed, is slightly more radical than the Miles technique.

I am in full agreement with Gabriel as to the existence of certain advantages with the perineo-abdominal type of maneuver, having employed a two-stage variation of this operation on numerous occasions, but disagree with his advocacy of a "blind" one-stage operation without preliminary laparotomy. Anticipating such criticism on the score of possible liver metastasis being present, he stated that in a series of twenty-nine cases his preoperative estimate of operability was substantiated. Nevertheless the most experienced surgeons will occasionally fail to realize the existence of metastasis until the abdomen is opened. Rankin reported that in 919 cases in which laparotomy was performed, over a period of six years 385 cases (41 per cent) proved inoperable because of metastasis of the liver (100 cases), general lymphatic involvement (forty-three cases), and so forth.

In many of these cases the weight of the patient was normal, determinations of the hemoglobin revealed normal percentages, and the growth was mobile, yet at exploration evidences of generalized metastasis was noted. Particularly was this true in instances of youthful individuals harboring tumors of a high degree of malignancy in accordance with Broders' classification. In 1935, Rankin[13] reported a series of cases in which exploration was carried out through a McBurney incision and cecostomy established; subsequently perineo-abdominal resection was consummated. I believe this maneuver has a wide field of usefulness and that it will be applicable in many instances in which the procedure of Miles would be contraindicated.

Unquestionably there are robust individuals who, carefully prepared and selected, may withstand a formidable procedure in one stage which would prove entirely too strenuous for one less vigorous or more advanced in years. Coller and Ransom,[14] in 1936, stated that their mortality rate was only 8.3 per cent in forty-eight combined abdominoperineal operations done in one stage. With an increase in the operability rate the mortality likewise rose. Their first cases weres elected with great care; subsequently they accepted for operation patients aged more than 60 years and of these seven died, six as a result of pneumonia or heart disease. Their early experience strikingly emphasizes the fallacy of deductions based on a small series of selected cases; their later experience convinced them of the advisability of returning to a somewhat more conservative selection of patients for the radical operation.

COMBINED ABDOMINOPERINEAL AND PERINEO-ABDOMINAL RESECTION IN TWO STAGES

For the less favorable risks—and this is a fairly numerous group of cases—a two-stage operation is indicated. More specifically, the indications for such a procedure are: (1) local complications such as an unusually large growth with little mobility, fixation to adjacent viscera or structures, or definite evidence of infection about the growth; (2) where double resection of the large and small bowel or bladder is required; (3) anatomic types such as extreme obesity; (4) coexisting debilitating diseases such as diabetes and cardiorenal vascular diseases; and (5) senility, i.e., in most patients who have passed 60. Obstruction unrelieved by preoperative medical measures will, of course, require preliminary drainage, which is usually by cecostomy, but upon relief of the obstruction, if there is no other contraindication, a one-stage combined type of maneuver may be elected. Many growths deemed inoperable at primary exploration recede to such an extent after the sidetracking of the fecal current and constant irrigation that radical operation becomes feasible and results are entirely satisfactory. Fixation has resulted more often from inflammatory reaction than from malignant extension.

The two-stage combined operations now popular vary somewhat in technical details and in scope, but the fundamental principles of all of them may be traced to the classic one-stage procedure of Miles. The type advocated for many years by Daniel Fiske Jones[15] has much to recommend it. An advantage which it possesses is that a radical procedure is carried out at the first stage without the necessity of opening the bowel; a disadvantage is that loop colostomy is established. The results, both immediate and remote, as reported by Jones, have been excellent, and their significance is enhanced by the accurate and detailed presentation of the statistics.

Rankin,[16] in 1929, described a procedure in which at the first stage a single-barreled or end colostomy is made and the divided distal end is inverted and dropped back; at the second stage a perineo-abdominal excision is consummated. One year later Lahey[17] modified this operation by bringing the lower end of divided sigmoid out of the exploratory incision for purposes of irrigation between stages. I have not employed

this modification because of the belief that if obstruction was present one divided the bowel at greater increased risk and if obstruction was not present in a marked degree, irrigation could be arranged with a two-way tube in the rectum just as satisfactorily. Moreover, Lahey's method necessitates, at the second stage, inversion of the end of bowel which he now brings out of a stab wound, and the peritoneal cavity is subjected to possible contamination from this source.

Because of the many disadvantages of the Coffey operation, I see no advantage in its employment under any circumstance. The mortality attending this procedure, judging from recent reports, is prohibitively high. From the technical standpoint it may be impossible to telescope the distal end of the bowel through the constricted lumen of the rectum at the site of the growth, and failure of collateral circulation may and not infrequently does give rise to necrosis of the inverted distal end of bowel and pelvic cellulitis. In a series of twenty-six cases of anterior resection of the rectosigmoid, reported by Rankin,[18] in 1928, three instances of failure of the blood supply to the inverted and retroperitonealized upper portion of the rectum were encountered. As in the Coffey procedure the superior hemorrhoidal artery was ligated. As a consequence of this complication the employment of the procedure was soon discontinued.

COLOSTOMY AND POSTERIOR RESECTION (PERINEAL EXCISION)

For growths beneath the peritoneal reflection, particularly if low in the rectum, this procedure is satisfactory from the standpoint of operative mortality and the comparative ease with which it can be accomplished. On the other hand, this operation does not permit excision of the node-bearing tissue in the vicinity of the rectosigmoid and in the mesentery of the sigmoid as thoroughly as by the combined abdominoperineal maneuver. The high rate of recurrence following perineal excision led Miles to design the combined operation. In his series of fifty-eight survivals of perineal excision, fifty-five were known to have died from recurrence, a rate of recurrence of 94.8 per cent. While it is still true that recurrence is more frequent after posterior excision than when the radical combined maneuver is employed, nevertheless there is ample statistical proof that the former can be carried out in a group of cases which are such grave operative risks that the latter is not to be considered. Five-year cures of 38 per cent have been reported in 300 cases (Rankin[19]) and 50 per cent in 209 cases (Lockhart-Mummery[20]).

Owing chiefly to the efforts of Lockhart-Mummery, perineal excision has been changed from a purely palliative procedure to one of distinct usefulness in the cure of lower rectal growths in instances in which the more radical operation is contraindicated. He emphasized the fact that operation usually has to be performed on elderly persons and on those who, either because of their age or other infirmities are not very good surgical risks. One hundred thirty-seven of his patients were aged more than 60 years, and thirty were over 70 years. In 167 cases from his private practice there were only six deaths, a mortality of less than 4 per cent. Of 209 patients in whom operation was carried out five years or more previously, approximately 50 per cent survived as five-year cures.

Contrary to an apparently widespread belief, Lockhart-Mummery[20] neither advocates nor employs perineal excision to the exclusion of all other procedures. He states that his operative procedure is suitable in any case in which the growth is at the anus or anywhere in the rectum proper, provided it is not fixed to important structures; it cannot be performed if the growth is at or above the rectosigmoid junction unless the growth is small and the sigmoid fairly lengthy. A high growth, he states, ordinarily "should be removed by an abdominoperineal operation, or if the surgeon finds himself in difficulties owing to the fact that

the growth is too high to be removed safely from the perineum, he may reverse the procedure, and after freeing the rectum below, close the posterior wound, turn the patient on his back, and complete the operation from the abdomen—in short, do a perineo-abdominal resection."

ANTERIOR RESECTION OF THE LOWER SIGMOID AND RECTOSIGMOID

Neoplasm situated low in the sigmoid occasionally constitutes a separate problem. It cannot be exteriorized without extensive mobilization of the rectosigmoid, hence the patient is subjected, as a rule, to abdominoperineal operation of some type. From the standpoint of curing the disease such a course is entirely satisfactory but there are instances, admittedly rare, in which a more conservative procedure without sacrifice of the rectum probably is justifiable. If the growth is situated well within the peritoneal cavity, at least 5 cm. from the reflection of the peritoneum on the bowel, an obstructive resection with subsequent restoration of the continuity of the bowel may be considered, provided that: (1) the growth is small and of a low grade of malignancy (grades 1 and 2), as determined by biopsy through the sigmoidoscope; (2) the growth is a polypoid one of doubtful benignancy; or (3) the patient refuses permanent colostomy. However, not infrequently factors are present which make such a procedure inadvisable, chief among which is marked inflammatory reaction or formation of abscess in the vicinity, marked adiposity, and instances of a short sigmoid flexure. In 1936, Rankin and I[21] described for the low sigmoid lesion a modified obstructive resection, employing the Rankin clamp. David[22] previously had described a similar procedure which differed somewhat in the details of technique. Although convinced that these procedures may be employed advantageously in certain carefully selected cases, we did not lose sight of the fact that even in instances of low sigmoidal growths the ideal procedure, in the absence of contraindications, is a combined abdominoperineal operation, either in one or two stages. With Pfeiffer[7] we feel that the occasional success which attends anterior resection of the rectosigmoid does "not counterbalance the increased moribidity and mortality, as contrasted with frank adoption of permanent colostomy in all but highly selected cases." For growths which are situated in the rectosigmoid at or below the reflection of the peritoneum onto the bowel we believe a combined operation is invariably the maneuver of election.

SACRAL (OR KRASKE) RESECTION OF RECTUM

Sacral operations, which entail establishment of a perineal anus, have rarely been employed in this country or England in the last two decades, but on the continent, particularly in Germany and Austria, until very recently the sacral route has been used almost to the complete exclusion of all other maneuvers. Operative and recurrent mortality and the percentage of poor functional results have been excessively high. Only quite recently have a few surgeons in this country commenced again to advocate resection of the rectum which provides a perineal rather than an abdominal anus.

Although technically it might be designated as the Kraske type of procedure, the operation devised by Babcock[5] is as different from the traditional Kraske resection as Miles' operation is from the early perineal excision of the rectum. Babcock's operation is probably almost as radical as that of Miles and differs essentially from the latter in only one respect, namely, that a perineal anus is established rather than an abdominal one.

CONCLUSIONS

My intention here has not been to urge the most radical, hence the ideal operative measure in every instance, but with Daniel Fiske Jones I make a "plea for a 'sufficiently thorough' operation for every patient who can stand it." It is also my belief

that the saying "that the smaller and the earlier the growth and the better the chance of a cure, the more extensive should the operation be" holds good today as well as formerly. As T. E. Jones[11] recently stated: "It is an error to perform small operations for small cancers and big operations for big cancers: perhaps better results would be obtained if the plan were reversed." There will always be patients who are not sufficiently strong to withstand the ideal operation and many surgeons have not had sufficient experience to undertake it.

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THE PATIENT WITH A CARCINOMA OF THE COLON OR RECTUM

CHARLES GORDON HEYD, M.D., F.A.C.S.

Professor of Surgery, New York Post-Graduate Medical School, Columbia University

NEW YORK CITY

TO inform a patient that he has a malignancy of the large bowel or rectum is a task of great responsibility and requires a most sympathetic understanding of the psychology of the patient. Perhaps in the stress of practice the physician all too frequently fails to estimate the "blow" that is given to a patient when he is informed for the first time that he has a cancer. On numerous occasions I have tried to place myself in the position of the patient and to estimate as fully as I could the various factors that enter into the reaction of the individual.

Many years ago a very distinguished doctor told me that the surgeon who first tells an individual he has a cancer of the stomach or bowel seldom performs the surgery. The doctor proceeded to elaborate his idea as follows: the first reaction of the patient when informed of a malignancy is to have the diagnosis controverted by another opinion and even a third or fourth. After the patient has received two or three similar verdicts as to the seriousness of his condition the effect of any further confirmatory opinion does not occasion the spontaneous resistance that is brought forth when the first opinion was rendered.

It would therefore seem wise to analyze some of the emotional reactions that must be brought forth when an individual is faced with the necessity of considering surgery for a neoplasm of the large bowel. The questions that are usually asked, in the order of their importance, are: (1) Can the condition be cured? (2) How long will it take to get well? (3) What are my chances of surviving? (4) Will I have normal bowel function after the operation? After these questions are canvassed, the matter of expense and financial outlay presses for solution. Aside from such neoplasms as may be resected in one stage without loss of normal evacuating function the problem of malignancy of the large bowel is one that must consider the number of operations, the concomitant colostomy—either temporary or permanent—and the prolonged convalescence and withdrawal of the individual from his occupation or business.

How often have we heard the cry "I would rather die than have a permanent colostomy"; as a matter of fact, we have heard the same expression used by our colleagues and our professional friends. If the general practitioner takes such an attitude he will not be very optimistic in advising a patient with a carcinoma of the rectum to accept a splendid and properly executed surgical procedure which must carry with it a permanent colostomy.

However, it is important for the surgeon to recognize that in dealing with neoplasms of the large bowel and rectum the patient has an utterly different psychology from that which obtains in other surgical conditions. Cancer of the bowel is as frequent as cancer of the stomach but with a much greater prospect of cure. In cancer of the stomach the resection and reconstruction of alimentary continuity is established by a one-stage surgical procedure. A neoplasm of the bowel, however, involves a consideration of multiple operations, one or two-stage procedures, artificial anus and a prolonged convalescence with pain and discomfort, to say nothing of the abnormal mechanism for evacuation of the bowel. No other intra-abdominal surgical condition is attended with such a detailed consideration of so many factors. Therefore,

the surgeon must evaluate the patient's emotional sensitivity and his psychological equipment when discussing the details of his condition.

There is another and very important aspect of this subject. That is the question of secrecy. In newspapers, lectures and by radio all types of indigestion are freely discussed. In fact, cancer of the stomach invites widespread discussion in polite society. But how seldom are the complaints of the large intestine and rectum discussed and how infrequent is the presentation of the problem of malignancy of the large intestine, even at our medical societies. When these factors are combined with inherent modesty or affectation of prudery, it is not to be expected that an individual with colon symptoms will come to his doctor as readily as will those suffering from indigestion. Even the presence of blood in the stools will be tacitly assumed to be due to a hemorrhoid. There seems to be an inherent secrecy and attempt upon the part of the patient to disguise or to defer the recognition of symptoms until by their very prominence they at length force notice upon the individual.

Given three persons—one with carcinoma of the stomach, one with carcinoma of the colon and one with carcinoma of the rectum, it may be fairly assumed that the individual with carcinoma of the stomach will ordinarily have an entirely different reaction and psychology when informed of his condition than the other two. The patient with carcinoma of the colon will be on the whole more hopeful and optimistic than he with carcinoma of the rectum. The patient with a malignancy of the rectum who must pay frequent visits to the toilet to expel small quantities of feces, mucus and blood, with the rectal irritability and the unwarranted terror of a colostomy, represents a real psychological problem.

Innumerable people accept the aid of eyeglasses; a few of the deaf desire the additional help of an audiphone; but the thought of a colostomy as a means for the prolongation of life and part of the price that must be paid for a surgical cure of a neoplasm of the rectum seems to be unacceptable to many patients with malignancy. A colostomy is not a pleasant life companion, but it does not sentence the individual to social ostracism; one may live a relatively normal and useful life. It requires no bag, or particular apparatus, but does demand attention, education and training. The patient with a colostomy must spend a certain time each day in the care of it and must regulate his diet and habits to avoid accidents.

Patients react in varying degrees when told that they require surgery, but one and all react with fright and terror at the thought of a colostomy. It seems to be that here is a problem which requires sympathetic approach and counsel. I believe it is highly desirable to impart the information about cancer of the rectum by stages and not all at one time, and that it is a mistake to operate upon an individual for carcinoma of the rectum without a full understanding of the nature of and reasons for a colostomy. Psychologically, the patient gradually adapts himself to the sum total of all of the disturbing information and with the advice of the physician will rationalize his thoughts so that he will meet the prolonged seige and surgical procedures with optimism and hope.

It has been our experience that patients face the future after a surgical procedure for neoplasm of the large bowel and rectum if they are assured that the tumor has been removed. The late Dr. Jones of Boston made the observation that in his experience he had no suicides among individuals from whom he had removed the tumor, whether they had recurrence or not; but he had suicides among some of his patients if the tumor was not removed and only a colostomy had been performed.

Practically every individual in the cancer age has had some personal contact, either direct or indirect, with some person who has died a "cancer death." This has

affected his viewpoint and conditioned his reactions to the thought of "dying by inches." I recall one patient, a woman in her middle fifties upon whom I had operated previously. One day she came into my office with a history of rectal pain and bleeding. At the first interview I told her it was necessary to localize the source and place of the origin of the blood. On sigmoidoscopic examination it was readily determined that she had a malignancy of the upper portion of the rectum. A biopsy specimen was taken at the same time and I casually remarked that I would send the specimen to the pathologist to be examined. After a few days the histology of the specimen was determined and with the report of the pathologist before me, I entered into what I considered the most sympathetic and tactful form of approach, as to the desirability of removing the tumor and that the operative mortality was not great, and that she had at least a 50–50 chance of outliving her present condition. The thought of malignancy as such I do not think was the disturbing factor but the permanent colostomy was the hurdle that she could not, or would not take.

In the non-obstructive lesions of the cecum and ascending colon which are associated with depreciation of health, the approach to the question of malignancy can best be made by a consideration of the patient's general physical condition and disability. Ordinarily there is no necessity for haste. A week or ten days or two weeks spent in arriving at a plane of mutual acquiescence, provides a more willing and cooperative patient, and is more helpful than an appearance of haste on the part of the diagnostician.

After the surgery has been performed and the patient has survived the surgical trauma, particularly in the presence of a colostomy, great demands will be made upon the patience of the individual. This is particularly true with patients who have a temporary colostomy following an obstructive resection of the Mikulicz type. The importunity of the patient to have the bowel closed will make increasing demands upon the resiliency of the surgeon and there will be required of him a great degree of fortitude in the face of the demands to "close the d— thing." It seems well, therefore, that the patient should be repeatedly informed that the time element is not a matter of days, or weeks, but may cover some months. Uniformly better results have been obtained in my practice by delays that were the result of long holidays than when I succumbed to the blandishments of the patient and tried to expedite matters by forcing repair or closure.

It is obvious that the complete conduct of a case of colon or abdominoperineal resection with colostomy is a long job and with the rarest exceptions will not bring adequate remuneration and payment. One cannot dismiss a patient after a Miles operation without entering into the most minute details of his personal and conjugal life. Repeated explanations must be given of the importance of certain articles of diet and the reasons for certain minor complications, such as the inability of the patient to express freely the irrigating fluid after it flows readily into the colostomy. A few words of explanation: that this is due to contracture of the orifice; that it requires a "V" excision of the skin to enlarge the orifice, etc., will demand additional patience upon the part of the doctor. Again, the vesical symptoms after resection of the rectum may be most distressing to the patient. A sympathetic attitude at all times, together with a willingness to explain things, will do much to establish the patient's morale.

Does the surgeon realize the mental anguish of a patient with chronic diverticulitis of the sigmoid? Here is a condition, except for its complications, best treated by a medical regimen. From time to time there is an exacerbation of symptoms—pain and tenderness. The patient realizes the dangers of perforation and abscess formation. With each attack relatively the

same advice is given. Finally, the patient with a spirit not unlike that of the gambler presses for surgical relief. Under such circumstances the surgeon must not only show great spiritual courage but must inculcate the same fortitude in the patient. To say "no" to importunities for surgical intervention is a higher tribute to the physician's skill and character than to acquiesce.

Finally, it would seem that in no field of surgical endeavor are the psychic factors of the surgeon's advice so important as in surgery in the large intestine and rectum. The patient needs not only a surgeon but a counselor and a friend.

THE only benign tumors of the rectum and colon which one encounters with any frequency are the adenoma or mucous polyp, originating from the columnar epithelium of the mucosa, and the squamous polyp, which results from hypertrophy of an anal papilla.

IMMUNIZATION OF THE PERITONEUM*

FREDERICK A. COLLER, M.D. AND SHERRILL RIFE, M.D.

Professor of Surgery, University of Michigan Medical School

Instructor in Surgery, University of Michigan Medical School

ANN ARBOR MICHIGAN

SINCE the advent of major abdominal surgery the problem of postoperative peritonitis has been an extremely important one and still presents itself as a challenge to the surgeon from the standpoint of both prevention and cure. During the past fifty years there has been a large amount of work done on the production of peritonitis in various experimental animals, and attempts have been made to correlate the findings in animals with the peritonitis which occurs in the human being. Such attempts have been far from satisfactory and there is still need for more carefully controlled laboratory and clinical investigation in the field.

The early workers on experimental peritonitis found it difficult to produce a true fibrinopurulent peritonitis by the intraperitoneal injection of bacteria. They could earily produce a bacteremia, or, with more virulent organisms, could get a lethal effect, but not a peritoneal exudate. It therefore occurred to them that peritonitis per se was probably not the cause of death, but was in reality a protective mechanism, and that the animals, paradoxically enough, died from a want of inflammatory reaction rather than as a result of it. Herrman, in 1927, at the Mayo Clinic, showed that in order to produce a peritoneal exudate in the rabbit it was first necessary to build up an immunity before injecting the infecting material. This was successfully carried out by using repeated small intraperitoneal doses of a vaccine prepared from the colon bacillus and Streptococcus viridans. At autopsy the animals showed a true fibrinopurulent peritonitis, but control animals which received no such immunizing vaccine died promptly with no visible evidence of peritonitis. Today, this concept regarding the production of peritonitis is generally accepted, and comes to our attention every time we perform an abdominal operation. We know that the degree of resistance of the peritoneum will vary with the extent to which the peritoneum has been previously immunized. In cases of regressing acute cholecystitis, in which pus is spilled into the peritoneal cavity at operation, there is no grave danger from a subsequent severe peritonitis. This resistance of the peritoneum to a limited amount of infection is probably not due to any "natural" or "inherent" immune quality, but is more likely the result of an excellent blood and lymphatic supply.

Attempts to immunize the peritoneum by the intraperitoneal injection of vaccines and various foreign substances are by no means new. As early as 1887 Pawlowsky used croton oil to produce peritonitis in experimental animals. The problem was more actively studied by Issaef in 1894 when he introduced the idea of vaccination to prevent postoperative peritonitis. Pierralini, in 1897, found that a leucocytic exudate could be produced by the intraperitoneal injection of sodium chloride and other inert substances. In the same year Garniér demonstrated that bacteria were rapidly destroyed in the presence of such a leucocytic exudate in the peritoneal cavity, and his researches revealed a new concept regarding the mechanism of protection from an otherwise fatal peritonitis, namely phagocytosis. In 1902, Solieri, working on the theory that "immunity" was a result of phagocytosis, produced a peritoneal leucocytic exudate, and found that animals

* From the Department of Surgery, University of Michigan, Ann Arbor, Michigan.

with such an inflammatory reaction of the peritoneum survived a colon bacillus peritonitis.

The problem of peritoneal immunization was reopened in this country by Steinberg and Goldblatt in 1926, and since then they, working together and individually, have done a large amount of research on this phase of peritonitis. Their earlier experiments showed that intraperitoneal immunization by living and heat-killed colon bacilli produced an immunity to subsequent colon bacillus and fecal peritonitis. Later, in a series of experiments in which they studied the cause of death in peritonitis, they presented convincing evidence concerning the rate of passage of bacteria from the peritoneal cavity into the lymph and blood streams. Working with dogs, they found that when colon bacilli in saline suspension were injected intraperitoneally they were rapidly absorbed into the blood and lymph, and that such animals practically always survived. However, when equal doses of the colon bacillus were suspended in 1 per cent gum tragacanth, the animals did not get a bacteremia, but invariably diet. The hypothesis was therefore formulated that toxic products of the bacteria were formed in quantity only when they were retained within the peritoneal cavity, and that such toxic products were the cause of the death of the animal.

Concurrently, David and Sparks, in 1927, threw further light on the mechanism of absorption of bacteria, and helped to establish the belief that peritonitis serves a protective function. They showed in animals that when colon bacilli were injected intraperitoneally they passed readily into the blood and lymph. When, however, a plastic peritonitis was first produced by injection of a turpentine emulsion, organisms subsequently injected intraperitoneally could not be recovered from the blood stream or thoracic duct.

Peritoneal "immunity," so-called, is probably not a true immunity but a local form of protection which manifests itself as a reaction of the peritoneum to trauma and infection. In this connection, most students of peritonitis feel that phagocytosis plays an important protective rôle. There is, however, no uniformity of opinion regarding the relative protective functions of the polymorphonuclear leucocytes and the large mononuclear cells or histiocytes.

Since his earliest studies, Steinberg has contended that the protection secured from intraperitoneal vaccination is a result of phagocytosis of otherwise harmful bacteria. He regards the polymorphonuclear leucocyte as the important cell serving in this capacity, and has designated this type of protection "hyperleucocytic pre-immunity." He feels that the histiocyte is a "scavenger" cell which appears relatively late in peritonitis, where it can be demonstrated to engulf degenerated polymorphonuclears in this stage of the disease. He has emphasized the point that the polymorphonuclear cells act early in carrying out their phagocytic function.

At the Mayo Clinic the opinion has prevailed among the various workers that the histiocyte is probably the most important cell concerned with phagocytosis. Hermann early expressed this belief in his work on rabbits and since then it has been supported by other investigators. In 1933, an interesting study on the peritoneal fluid of man was carried out by Rixford. He had an opportunity to study the peritoneal fluid in patients at operation which had previously received intraperitoneal vaccine, and to compare these findings with a control group of patients which had received no vaccine. Specimens were taken with a glass pipette just after the peritoneal cavity was opened. In unvaccinated cases, the total white cell count averaged from 1,900 to 2,600 per c. mm. of fluid. There were practically no neutrophiles, very few eosinophiles and basophiles, but many lymphocytes and histiocytes (45 per cent). In patients who had been vaccinated 24 to 144 hours prior to operation, specimens of peritoneal fluid were also examined. There was considerable variation in the findings, but it was apparent that there was an early

increase in polymorphonuclear cells and a delayed but nevertheless marked increase in histiocytes.

The cell counts of the total peritoneal fluid have been carefully made by Seeley, Higgins, and Mann. Working with rats, they used various substances to evoke a peritoneal reaction, and then removed and weighed all the fluid present, in addition to making differential cell counts. Following injections of amniotic fluid concentrate, Bargen's vaccine (prepared from colon bacilli and nonhemolytic streptococci) and sodium ricinoleate, they found that with all materials there was an early and rapid rise of polymorphonuclears, reaching a maximum in three to six hours. Histiocytes appeared much later, but, were the preponderant cells after six or seven days. The response of both cells was greater in those animals receiving sodium ricinoleate.

In 1937, Corwin, working with rabbits, reported that the cellular responses to Bargen's vaccine and sodium ricinoleate were nearly identical qualitatively. The intervals for maximal cellular reactions varied, however. With Bargen's vaccine, the cell count of the peritoneal fluid was greatest at twelve hours, with 1 per cent sodium ricinoleate at twenty-four hours, and with 2 per cent sodium ricinoleate at forty-eight hours. The differential count again showed that polymorphonuclears appeared early, being in greatest abundance in six to twelve hours, while the histiocytes were maximal in one to three days.

It is apparent from the above studies that variation in opinion regarding the relative phagocytic properties of the neutrophiles and histiocytes is due in part to the use of different species of animals by various workers. The type of material used to evoke a reaction, the dosage employed, and the time intervals for examination of the fluid are also inconstant factors which must be evaluated in arriving at a definite conclusion.

In order to prove or disprove the value of any of the numerous agents that have been used to immunize the peritoneum, it would be necessary to use such an agent in a very large series of patients having major abdominal operations, and at the same time have an equally large number of similar cases as a control group. As yet no such investigation has been reported. However, during the past ten years there are three immunizing agents which have been employed more extensively than numerous other substances. These are (1) the vaccine developed by Steinberg and Goldblatt, (2) the vaccine prepared by Bargen, and (3) the amniotic fluid preparations originally suggested by Johnson.

Steinberg and Goldblatt, working on the idea that a marked leucocytic reaction in the peritoneal cavity could be more easily produced by some agent which prevented a rapid absorption of bacteria, developed a protective emulsion which they have called coli-bactragen. This preparation has since been modified by Steinberg, and his formula for the more recent preparation is as follows:

Tragacanth	1.5 Gm.
Aleuronat	0.5 Gm.
Escherichia coli (30 c.c.)	2,400,000,000
Salt solution 60.85 per cent	100 c.c.

Today there is ample evidence that this emulsion will protect the experimental animal from certain types of subsequently induced peritonitis. Steinberg has succeeded in demonstrating protection against living colon bacilli, streptococcus fecalis, B. pyocyaneus, and clostridia welchi, in both pure and mixed cultures.

In the collected series of 400 patients receiving coli-bactragen which were reported by Goldblatt in 1934, eight postoperative deaths were recorded, but only three of these could be attributed to peritonitis. In the majority of patients who were operated upon by various surgeons, a resection of a part of the large bowel was performed. The preparation employed was injected intraperitoneally about forty-eight hours before laparotomy was performed and was frequently accompanied by a rather severe general reaction. The patient

was occasionally so sick from the vaccination that operation was necessarily postponed. The series was too small, however, to permit any conclusions regarding the efficacy of the vaccine. The more recent preparation of coli-bactragen is an improvement over the former one, not only in that it produces a less severe general reaction, but has the additional advantage of achieving its maximum protection within a few hours, thereby permitting its being introduced at the time of operation. Steinberg has found that the period of maximum protection is shortened by using formaldehyde rather than heat to kill the colon bacilli.

In 1935, Potter and Coller reported their results on a series of patients who were given coli-bactragen prior to operation. In seventy-nine patients, most of whom required major operations upon the colon, there were eleven deaths, but in only one could the fatal outcome be definitely attributed to peritonitis. They noted that the peritoneal reaction varied from a mild hyperemia to an abundant exudate resembling that of a fibrinopurulent peritonitis. Although the series of cases was too small to permit definite conclusions, they were of the opinion that the value of the vaccine was questionable except in cases of gross fecal contamination. In 1936, Coller and Ransom reported the use of coli-bactragen in seventy-nine cases which had a combined abdominoperineal resection for carcinoma of the rectum and rectosigmoid. There were twelve deaths, but in none could death be proved to be the results of peritonitis. In the same year Steinberg reported 391 cases in which coli-bactragen was used preoperatively or at the time of operation, with none developing postoperative peritonitis.

In 1928, at the Mayo Clinic, based on experimental work done by Herrmann, Bargen developed a vaccine prepared from streptococci and colon bacilli. The vaccine was given three days before operation involving intestinal resections. In 1935 Dixon and Bargen reported having used the vaccine in 1,500 such cases, with a reduction of 66 per cent in the mortality rate from postoperative peritonitis. The reaction from the vaccine usually consisted in a temperature elevation to 102° or 103°F. which receded in a gyrate fashion and returned to normal twenty-four to thirty-six hours after vaccination. In 1930, Rankin, in a review of 527 surgical lesions of the large intestine and rectum in which peritoneal vaccination was used preoperatively, reported a mortality rate of 12.3 per cent by patient and 8.6 per cent by operation. In 1933, he began a new series of operations upon organic lesions of the colon and rectum in which the vaccine was not used. In 200 consecutive operations upon 130 patients he reported a mortality rate of 5.5 per cent by operation and 8.4 per cent by operation. Rankin has attributed the decline in mortality to better preoperative preparation rather than to vaccination.

Johnson, in 1922, first conceived the idea of using amniotic fluid to prevent postoperative adhesions, and since then he has used it as an agent to assist in the processes of peritoneal defense and repair. While the use of a substance which allegedly prevents adhesion formation but at the same time protects against peritonitis seems paradoxical, Johnson explains that the action of amniotic fluid on the peritoneum is to produced a protective layer of fibrin on the serous surfaces and a moderate local leucocytosis, which is followed later by a complete resolution of the fibrinous deposit. The amniotic fluid used is obtained from cows two to five months pregnant. It is sterilized by the Berkfeld filter method. Johnson is of the opinion that amniotic fluid provokes a peritoneal reaction which is entirely within the limits of safety, gives an early response, and produces only a minimum physiologic disturbance. He describes the peritoneal reaction as a "defense response characterized by hyperemia, marked subserous edema, increase in peritoneal fluid, and the formation of a pink-tinged fibrinous exudate. There is an increased white cell count

which rises rapidly for about twelve hours, at which time the differential count shows a marked preponderance of polymorphonuclear leucocytes. Having reached its peak, the white cell content of the exudate gradually recedes and the neutrophiles are replaced by the histiocytes. The total white cell count finally becomes preponderantly histiocytic." He states that when the exudate is removed from the peritoneal cavity it quickly forms a fibrin clot. By contrast he points out that following the intraperitoneal injection of vaccines there is a very severe reaction characterized by a profuse hemorrhagic exudate which does not clot upon removal and exposure to air.

Johnson's work has been collaborated in by Warren, Trusler, Young and Marks, Kimpton and others. In 1934, Young and Marks reported on the use of amniotic fluid concentrate in forty-nine cases which involved, for the most part, operations on the large intestine. There were three deaths, but in only one instance could death be attributed to postoperative peritonitis. In a series of forty-six similar cases in which amniotic fluid was not used preoperatively they reported eight deaths, or a mortality of 17.3 per cent, from postoperative peritonitis. In the latter group, when they included only the cases in which the bowel was resected, there was a mortality of 38 per cent. In 1936, Gepfert reported on the use of concentrated fractions of bovine amniotic fluid (amfetin, Lilly). He was of the opinion that patients receiving amniotic fluid had a smoother postoperative course than did a similar group of control patients.

Further studies in nonspecific peritoneal immunization were reported by Morton in 1931. He used various substances to vaccinate the peritoneum, particularly dextrose broth, heated streptococcus filtrate, various solutions of glucose, and sodium chloride. Using rabbits, he found that he was able to establish a certain degree of protection in most of the animals at the end of sixty hours, and, at the end of several days, "immunity was proved in 100 per cent."

The use of bacteriophage has given a variety of results, both experimentally and clinically. Rice gave a negative report of his work on local immunization by the use of bacteriophage in 1933. Immunization of the peritoneum of dogs was attempted by injecting intraperitoneally a mixture of staphylococcus, streptococcus, and B. coli bacteriophage filtrates. The animals were given bacteriophage before or at the time of operation, which consisted in tying off the cecum in order to produce peritonitis. Under the conditions of the experiments, it was found that the bacteriophage failed to immunize the peritoneum. Moreover, it seemed to inhibit the formation of plastic exudates when used before or during operation. Rice expressed the opinion, however, on the basis of previous clinical experience, that bacteriophage was of value in treating abscesses which were well walled off.

Jern, Harvey, and Meleney, working with mice, reported in 1932 on their use of bacteriophage to protect against colon bacillus peritonitis. They found that they were able to protect the animals against such an infection, even when they used doses twenty-five times the lethal dose for normal controls. The phage was effective when used intraperitoneally before, during, or even several hours after the injection of the colon bacilli.

It is apparent that numerous difficulties are encountered when one studies the problems connected with the use of bacteriophage. There is a marked difference in the susceptibility of various strains of the colon bacillus to lysis by bacteriophages. Against the streptococcus, which is probably the second most common, and one of the most virulent, organisms causing peritonitis, there are few active bacteriophages. Moreover, the behavior of a bacteriophage is unpredictable; it may fail to cause lysis of a particular strain of organisms but at the same time be effective in causing lysis of unrelated bacteria. At present it cannot be

said that there is sufficient clinical evidence to prove the value of any of the single or combined bacteriophages, but there are sporadic reports of success in treating a relatively small number of peritonitis.

Filtrates have been used several years to immunize the peritoneum, but up to the present time there is very little evidence, either experimental or clinical, to indicate that they are of value. Further work will be necessary to elucidate regarding their present contradictory status.

In spite of the fact that there has been a large amount of thorough experimental work on the immunization of the peritoneum, there still remains a wide gap to be filled if our experimental knowledge is to be applied to the human being. Such factors as the species of laboratory animal used, type and dose of immunizing substance employed, and the time and mode of its administration, make it difficult to compare the findings of one investigator with those of another. It is logical to assume that the peritoneum of one animal will not react in the same manner as the peritoneum of another, and that they will all differ in some respects from that of the human. Any absolute proof regarding the value of immunization in the human would necessarily depend upon results obtained in a very large control group of similar cases in which no immunizing agent was used. As yet no adequate control series has been reported.

From a clinical viewpoint, the newer concept of the protective value of the exudate in peritonitis has a practical value. In operations done upon patients with peritonitis it would seem harmful to carry out manipulations designed to wipe or wash away exudate that is part of a protective mechanism against the infection. If free exudate is removed it must be done in the gentlest fashion by careful aspiration.

CONCLUSIONS

We can see no reason for the routine use of any of the substances suggested to increase the immunity of the peritoneum. If patients are properly prepared for operation, and if the operation is carried out with careful meticulous technique, peritonitis rarely supervenes. We do feel that the use of some substance that will produce rapid local leucocytic response is of value in those instances in which, because of accident of operation or disease, the large bowel is opened. Our own experience in these circumstances has been most extensive and most satisfactory with colibactragen (Steinberg). We feel that it has a distinct value when used in the contaminated stage, and that it has little or no value once the infected stage is established. Postoperative peritonitis in clean cases is usually due to errors of operative technique that cannot be corrected by the introduction into the peritoneum of anything except better surgery.

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SYMPATHECTOMY IN MEGACOLON (HIRSCHSPRUNG'S DISEASE)*

A DISCUSSION

FREDERICK S. WETHERELL, M.D., F.A.C.S.

SYRACUSE, NEW YORK

NUMEROUS types of medical and surgical treatment have been suggested in the treatment of Hirschsprung's disease. No attempt is made here to enumerate the various theories advanced as to its cause, nor to evaluate any of the treatments except sympathectomy. When megacolon is met with during an abdominal emergency, it must be treated in the best method known to the surgeon, as suggested by Whitaker.[1] When a case under investigation developed what appeared to be an acute obstruction, a cecostomy was done, followed by aseptic electrosurgical resection and colectomy. Colectomy is not a new procedure in idiopathic colon, but it should not be necessary. This does not apply, however, to dolichocolon.

To clarify the existing confusion regarding the condition known as megacolon or Hirschsprung's disease (in either case an enlarged colon) attention should be directed to variation of megacolon. While there is some difference of opinion, it can be said that there are two types. In one the colon is extremely long (dolichocolon) with a long mesentery. This, because of its length, is extremely mobile and therefore likely to hang down over the more fixed portion at the upper end of the rectum. This results in a kinking of the tube at that point, much as a thin-walled rubber hose would act. Gas and fecal material collect proximal to the bend and there is a resultant dilatation and hypertrophy of the colon. This is a common finding during an abdominal section in these cases. An enormously distended colon with a thickened and hardened wall is often seen as far down as the brim of the pelvis, while from that point distally the gut is normal in size. It is this type of case which has given the most trouble in attempts to secure relief by resection of the superior hypogastric plexus (presacral nerve). It is not to be confused with true Hirschsprung's disease in which no natural bowel movement has taken place since birth. This is not true in cases of dolichocolon.

The second type, or idiopathic megacolon (Hirschsprung's disease) presents a colon the mesentery of which is probably still a normal length. The length of the colon is accounted for by the enormous distention of the pelvic colon. In this condition we are probably dealing with a hypersensitive or overactive sympathetic nerve reaction which, it is thought, causes a hypertonic spasticity at the pelvirectal flexure and the internal rectal sphincter, with ensuing achalasia. The opposite of this condition may be the causative factor, viz., a hypoactive sacral outflow (parasympathetic).

While resection of the lumbar paravertebral ganglia, or extirpation of the superior hypogastric plexus has been tried in both conditions, it is in the last described one that the best results have ensued. It is also in the idiopathic (so-called) megacolon that occasional good results have followed a spinal anesthetic and carefully conducted régime thereafter.[2] My experiences with spinal anesthesia have not been so satisfactory as those of others, but cases in which it has failed have responded to sympathectomy. It is, of course, possible that true dolichocolon was present, in which event it is not expected that spinal anesthesia would be effective.

* From the Department of Surgery, Syracuse University College of Medicine.

However, two patients have been benefited by sympathectomy after a trial with spinal anesthesia. Both were males under 8 years of age. One had a left lumbar ganglionectomy, the other, a left lumbar ganglionectomy, followed a year later because of continued episodes of ballooning-up, by a resection of the superior hypogastric plexus. Both boys are doing well at this writing, four years later, but a strict watch must be kept on their daily bowel habits, and occasionally an enema must be given. This care after operation is most important. It may, in itself, mislead us as to the effect of sympathectomy. If however, a similar and equally good type of régime has preceded the operation for years, it is fair to assume that the surgical procedure has benefited the patient. The same applies to the test of spinal anesthesia

In an excellent study of anal achalasia and megacolon, Hurst[3] calls attention to several cases in which the disease existed for a number of years, in fact well into adult life, without untoward effect on the individual, except for constipation. He calls attention to the main object in the treatment which is to lessen the resistance offered by a closed anal sphincter to the passage of feces and gas. He suggests the use of an anal bougie which he left in place for half an hour, after a first morning attempt has been made to move the bowel. He states that often after removal of the dilator a movement follows. This simple method, along with enemata, in some cases given in the knee-chest position, and then, if without result after fair trial, resort to spinal anesthesia, is correct treatment in all cases, and particularly in children, when the disease is first noticed.

Results in my hands, following sympathectomy of the superior hypogastric plexus and the inferior mesenteric branch, or, with lumbar sympathectomy alone in some cases, lead me to believe that the operation is of distinct value in cases of true Hirschsprung's disease when conservative measures fail. The point has been made that the anal achalasia is more likely to be due to underactivity of the parasympathetic supply, which militates against relaxation of the internal sphincter. The resulting inbalance is very likely only empirically brought nearer to normal by sympathectomy, yet the result should justify the means.

Colectomy should not be necessary if early relief is found by any of the means heretofore suggested. However, it is probably the only method of relieving a true dolichocolon.

The technique of the operation of superior hypogastric resection is too well known to be here described in detail. However, it should be remembered that many fine fibrils of nerve tissue may be overlooked if a careless resection is done, and that impulses may still be acting on the sphincters, enough it is quite possible, eventually to destroy any good effects which might have followed complete operation.

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WATER AND CHEMICAL BALANCE IN SURGERY OF THE COLON

THOMAS G. ORR, M.D.

Professor of Surgery, University of Kansas

KANSAS CITY, KANSAS

THE average patient with a non-obstructive lesion of the colon requiring operation is not dehydrated or suffering from demineralization. He may be in a poor state of nutrition from lack of food intake, making him a favorable candidate for a deficiency in blood protein which predisposes to nutritional edema following operation. Dehydration and hypochloremia are not usually present in marked degree even in obstructive lesions of the colon as they frequently are in such lesions of the small intestine, since vomiting is rarely an important symptom of the former except in advanced cases.

In most of the cases requiring surgery of the colon the problem of dehydration begins when the patient is being prepared for operation. Newburgh, Wiley, and Lashmet[1] have found that normal adults eliminate approximately 1,000 to 1,500 c.c. of water daily as insensible fluid loss through the lungs and skin. Coller and Maddock[2] estimated the insensible loss of fluid of sick surgical patients as 2,000 c.c. per day with frequently as much as 2,500 c.c. per day when the patient has a fever. It is very evident that the insensible loss of water must be one of the first considerations in the water balance of all surgical patients.

The maintenance of water balance prior to operation is essential. Even if the patient is not obviously dehydrated the intake may be below normal or water may be lost in preoperative preparation, especially if active catharsis is used to empty the colon. Patients should be urged to drink at least 3,500 c.c. of water during the twenty-four hours preceding operation and should be permitted to have water up to three hours before the operation is scheduled. Too often patients are deprived of water during the night preceding the operation and are sent to the operation with water deficiency.

If there is any reason why a patient cannot take water by mouth before operation or if there is doubt that sufficient water has been taken, 1,000 to 2,000 c.c. of 5 per cent dextrose in physiologic sodium chloride or Ringer's solution should be given by vein the morning of the operation.

When the operation is prolonged fluid should be administered during the operative procedure. Blood loss at operation must be added to the insensible loss of fluid. In some of the more extensive operations upon the colon and rectum, hemorrhage and shock are vital factors. A transfusion of 500 c.c. of blood is usually indicated either during or immediately after the operation. This may be given as citrated blood by the drip method.

The daily water need of the sick surgical patient has been quite accurately estimated by Coller and Maddock. Two liters should be supplied to replace water lost by vaporization, and 1,500 c.c. to produce a normal urinary output. The quantity needed for the average adult surgical patient is 3,500 c.c. per day plus the measured quantity of any abnormal fluid loss by vomiting, bleeding, wound drainage, drainage from intestinal or biliary fistulae and diarrhea. If the patient cannot take fluid by mouth it should be supplied parenterally by intravenous and subcutaneous injection. Five per cent dextrose in physiologic sodium chloride or Ringer's solution is usually used.

At this point it should be remembered that nature never planned that the human organism be watered and fed by vein and that certain dangers may be inherent in

such treatment. Experience and experimentation have taught that all solutions administered intravenously should be given slowly by the drip method or by carefully measured flow. A rate of 60 to 90 drops or 4 to 6 c.c. per minute has proved satisfactory. Gilligan, Altschule and Volk[3] found the blood volume increased after intravenous injection of the solutions mentioned above, which was more marked the more rapidly the injections were made. Since many patients requiring colon surgery are advanced in years and may have crippled cardiovascular systems, the slow administration of intravenous solutions is a very important safeguard. Other possible dangers are reactions with chills and fever, thrombosis at the site of injection in the vein with embolism and general edema resulting from the injudicious use of sodium chloride.

The quantity of sodium chloride necessary to maintain chloride balance has been estimated by Coller and his associates.[4] If 560 mg. of sodium chloride per 100 c.c. of plasma is taken as a standard normal, the chloride requirement may be estimated as follows: For each 100 mg. per cent that the plasma chlorides need to be raised to reach the normal 0.5 Gm. of sodium chloride per Kg. of body weight should be given. If whole blood chlorides are determined and 450 mg. of sodium chloride per 100 c.c. of blood is used as the standard normal, 0.6 Gm. of sodium chloride per Kg. should be used to raise the whole blood chlorides each necessary 100 mg. per cent to restore them to normal.

Intravenous injections are advised in broken doses rather than by continuous venoclysis as recommended by some authors. An injection of 2,000 c.c. may be given intravenously, beginning early in the forenoon and followed by a rest for a few hours at midday. A second injection of 1,500 c.c. intravenously or by hypodermoclysis may be given in the afternoon and early evening. The patient should not be disturbed by injections from 11 P.M. to 7 A.M. except in the initial treatment of severe dehydration. Blood chemistry and urine studies are made at least every second day until normal intake of fluid and food by mouth are started.

There is danger of giving too much sodium chloride, especially to badly depleted patients deficient in protein. Excess of salt causes edema in the subcutaneous tissues and, according to Jones and Eaton,[5] may cause edema of the parenchymatous organs. The following report is a typical example of the excessive postoperative administration of sodium chloride:

Case 1. R. G., age 49, was admitted to the University of Kansas Hospitals with a history of an acute attack of abdominal pain with vomiting. A large tender mass was found in the right abdomen which was diagnosed as an abscess of unknown origin. Pain, fever, and leucocytosis subsided in ten days and the patient was discharged to return later for observation. The mass did not entirely disappear and a barium enema showed a large defect in the ascending colon typical of carcinoma. He was readmitted to the hospital for operation. Before and after his last admission to the hospital he had had several chills.

Operation revealed a large mass in the ascending colon adherent to the pancreas, duodenum and gall-bladder. There were large metastatic nodules in the liver and mesentery. A lateral ileocolostomy was done.

Following the operation there was abdominal distention and vomiting. An indwelling nasal tube with continuous gastric suction was used for eight days. Daily injections of 2,000 c.c. of 5 per cent dextrose in Ringer's solution and 1,500 c.c. of Ringer's solution were given.

On the sixth postoperative day edema of the feet and ankles, flanks, and scrotum developed. The plasma protein was 5.21 Gm., globulin 2.56 Gm., and albumin 2.65 Gm. per 100 c.c. of blood. The plasma protein had dropped to the "critical level" and edema had developed. Too much sodium chloride had been given. The chloride solution was reduced to 500 c.c. per day and two blood transfusions of 500 c.c. each were given on successive days. Intravenous injection of 5 per cent dextrose was continued. In four days the edema had almost completely disappeared.

During this time the intestinal function had returned and protein food was started by

mouth in small quantities. The blood chemistry showed only a slight increase in the non-protein nitrogen and a slight decrease in the blood chlorides during the period of continuous gastric suction and development of edema. The patient recovered from the operation.

This patient had been ill for three weeks prior to the operation and had taken a limited protein diet. With a low blood protein, edema was rapidly produced by giving too much sodium chloride.

Another type of change in body chemistry is illustrated in Case II.

Case II. P. H. F., age 66, was admitted to the University of Kansas Hospitals, August 20, 1938. He had noticed a movable mass in his right abdomen for one year. A diagnosis of carcinoma of the cecum was made. The cecum, ascending colon, and a portion of the transverse colon were resected by the Lahey technique. Following the operation he developed a rise in the blood non-protein nitrogen, creatinine, and sugar, and a fall in the chlorides and cholesterol. These changes are shown in Table I. The urine was normal on admission. From the tenth to the forty-third postoperative day at various times the urine showed a specific gravity of 1.010 to 1.019, finely granular and coarsely granular costs, red blood cells and pus cells. The twenty-four hour output of urine was never below 600 c.c.

TABLE I

CHANGES IN BLOOD CHEMISTRY OF CASE II

Day after Operation	Non-protein Nitrogen, Mg. per 100 C.c.	Creatinine, Mg. per 100 C.c.	Sugar, Mg. per 100 C.c.	Whole Blood Chlorides, Mg. per 100 C.c.	Cholesterol, Mg. per 100 C.c.		
					Total	Esters	Per Cent Esters
0	35	1.1	81	440			
3	27	1.4	90	450			
7	111	2.5	89	450	198	116	58
8	150	2.5	95	370			
9	128	2.3	115	470			
10	154	3.2	113	380	185	91	49
11	110	2.6	133	310	161	63	39
12	107	2.0	118	300			
13	100	2.6	118	320	157	51	39
17	45	1.2	86	425	107	68	63
21	41	1.2	83	510			
25	30	1.2	83	460	138	83	60

The urine and blood chemical findings in this case are in keeping with what has been described as a hepatorenal syndrome or what Rosenbaum[6] has called an entero-hepatorenal syndrome. If this explanation of the changes in blood chemistry is accepted the conclusion is drawn that the operative procedure on the colon resulted in pathologic changes in both liver and kidneys. The increase in the blood sugar shown in the table during the days showing increase in the non-protein nitrogen is probably due to the increased intake of dextrose during that period to supply the liver with glycogen and produce diuresis. During these same postoperative days there was a decrease in the total cholesterol and in the percentage of esters. It is suggested that the changes in cholesterol may have been a result of liver damage.

The oxygen need in patients suffering from dehydration and decrease in blood electrolytes is as yet but poorly understood. Fine[7] has shown that the adminisintration of high percentages of oxygen increases gas absorption from a distended intestine. Davis,[8] in his studies in water balance, has observed a marked lowering of the basal metabolic rate in certain nutritional states with a very definite increase in oxygen consumption after the

injection of 0.9 per cent sodium chloride and 5 per cent glucose solution in dehydrated animals. It has also been suggested that the permeability of the capillaries is increased in starvation due to a lack of oxygen supply to the tissues.[9] Following operations upon the intestinal tract the administration of water and electrolytes aids in maintaining metabolic balance. Oxygen therapy is indicated in severe toxic conditions when there is postoperative abdominal distention, a change in blood chemistry, and lung or heart complications. Oxygen should be administered early and should not be left as a last resort measure.

SUMMARY

Following operations upon the colon resulting in disturbed function of the alimentary tract, dehydration and changes in body chemistry may rapidly become factors of prime importance. Dehydration usually plays the most important rôle in the disturbance of metabolism in general. As a result of dehydration there develops impairment of circulation and oxygenation, impairment of kidney function, retention of metabolic waste products, and disturbance of the heat regulating mechanism. Acid-base imbalance develops when there are extreme changes in body chemistry. Although the clinical terms "alkalosis" and "acidosis" are frequently loosely used and poorly understood, they must be considered in the changes of chemical balance associated with surgical diseases of the gastrointestinal tract.

The treatment of dehydration alone is relatively simple, but in surgical conditions dehydration is so much involved with changes in the body chemistry and metabolism that therapy becomes complicated. The judicious administration of water and sodium chloride tends to restore body chemistry to normal but does not entirely fulfill all therapeutic requirements of disturbed metabolism and pathologic changes that may result from water, chemical, and food deficiency.

In a study of water and chemical balance from the surgical standpoint the loss of water and chlorides are not alone to be considered, but a broad view must be taken of changes in body chemistry and metabolism which may result not only from the disease but from the surgery instituted to cure or alleviate the disease.

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REGIONAL ILEITIS*

BURRILL B. CROHN, M.D.

Associate in Medicine, New York Post-Graduate Medical School, Columbia University

NEW YORK CITY

IN a recent article by E. C. Cutler of Boston, the author indicates that in "cicatrizing enteritis surgery is not a cure, that recurrence following radical resection is frequent, and that patients may recover spontaneously." He expresses the hope that "the patient will be retained in the hands of the family physician, thus avoiding the sufferings which accompany surgical therapy." These remarks emanating from an eminent surgeon are all the more significant and call for due consideration and an answer without bias or prejudice.

The questions which are raised by this query are:

1. Is regional ileitis or cicatrizing enteritis capable of spontaneous recovery?
2. Is the disease successfully treated by medical means?
3. Is the surgical approach accompanied by danger and suffering?
4. Are recurrences after resection common?

I prefer to give only my own experiences covering 130 cases of regional ileitis, by which comprehensive title are included terminal ileitis, more diffuse regional ileitis, and finally high ileitis and jejunitis or, as the latter is sometimes named, cicatrizing enteritis. This large number of cases—large for a disease only recently recognized as of clinical importance—includes a majority of cases treated surgically and a minority (about forty-five cases) treated by conservative or medical means, or postponing operation.

1. IS ILEITIS OR ENTERITIS CAPABLE OF SPONTANEOUS RECOVERY?

Yes, when one speaks of acute ileitis, that type of terminal ileitis which simulates acute appendicitis, an "acute abdomen" characterized by lower right quadrant pain, fever, rigidity, leucocytosis and a suggestion of a mass. The diarrhea is usually overlooked. In most of these cases the appendix is removed (a superfluous gesture) and the fulminating ileitis is returned to the abdomen untouched. A majority of such cases will resolve, possibly never to be heard from again (eight out of eleven cases).

However, complete resolution may not occur, for some patients eventually develop the full picture of a chronic regional ileitis with mass, fistulae, and even obstruction. One such typical case was observed for a year and one-half. The onset was subacute and moderate, with low-grade fever and abdominal pain, but with diarrhea. The rule not to regard any case with diarrhea as acute appendicitis was an accurate gauge in this instance. The *x*-ray examination was negative, no deformity of the ileum being recognizable. Operation was therefore denied and a period of observation and medical (?) treatment prescribed. Six months later, symptoms persisting, the patient was again subjected to study. A barium enema now revealed a slight fuzziness and an indistinct outline to the terminal ileum. Another period of observation over a full year followed, with intermittent bouts of diarrhea and slight fever. A third radiogram now evidenced a typical "string sign" deformity of the terminal ileum. At operation, 18 inches of terminal ileitis was successfully resected; the patient has remained well to date (two years). This case is not an unusual one and is characteristic of the common course of the disease.

That the fulminating acute ileitis can and may resolve is gladly conceded, but that such spontaneous recovery is a peremptory

* From the Medical Services of Mt. Sinai Hospital, New York City.

rule is doubtful, even after reperusal of Koster's paper[1] claiming resolution in six such instances. It is my feeling that most of the acute cases of ileitis will eventually be found among the chronic cases with cicatrizing lumen, mass formation and obstruction, though it may take years before this indolent granulomatous malady presents itself with obvious and manifest symptoms.[1]

There is pathologic evidence of a healing tendency in regional ileitis, that is, cicatrization takes place, scar tissue is formed and contracts. The evidence for such a healing process lies in the cases of subacute intestinal obstruction in which the lumen of the ileum is so diminished by scar tissue contraction that obstruction results. In my own experience, such attempt at healing of a granulomatous process is not true healing, but represents only the throwing out of cicatricial fibrous tissue that accompanies the active stage of all chronic inflammatory processes. Such a contracture of the lumen of the intestine does not represent a last-stage healing of a previously active lesion; it goes always hand in hand with an actively progressing lesion at the more proximal areas of the process. At the oldest site there may be seen scar tissue with cicatrization; at the more recent areas active extension. This, therefore, cannot honestly be interpreted to mean that ileitis is capable of spontaneous healing with restitution to normal tissue and normal functional capacity.

And even if such healing were conceivably possible, if the healing of the granulomatous tissue took place in such a manner that health were restored but functional integrity were impaired or destroyed by the narrowed scarred lumen of the intestine leading to obstruction, then such spontaneous healing by conservative medical means would defeat its own purpose.

This may be construed as an overstatement of the case, as a morbid or pessimistic envisionment of the problem. Perhaps, it may be argued, chronic granulomatous ileitis is actually capable of complete healing with a return to normal health and integrity of the bowel, without scarring or cicatrization. Such an optimum happening I have never seen; once a lesion is established by radiographic evidence, the deformity of the bowel remains whether the clinical symptoms improve or do not improve. The defect stays until surgically resected. Like all other chronic diseases ileitis may have long periods of remission and apparent quiescence, but unless radiographically one can demonstrate the disappearance of the lesion in the intestine, healing cannot be said to have occurred. True, with short-circuiting operations, subsequent resection will often show distinct scarring of the involved area with replacement of the lost mucous membrane and a complete quiescence of the lesion. This is veritably "healed ielitis," but by no stretch of imagination can a short-circuiting operation be construed to be synonymous with conservative medical means.

2. Is chronic ileitis to be successfully treated by medical means?

What medication can be expected to be successful in a disease the etiology of which is still an enigma? Most patients with ileitis present themselves with a history of several months or years, many with an intermittent history covering five, ten, or more years. These cases have all been "treated medically," usually with intestinal sedatives, opiates, non-roughage diet, light therapy, etc. In no way does the inexorable course of the malady seem changed or ameliorated.

The history of such patients is usually a progressive one of increasing pain and diarrhea, slow but uninterrupted loss of weight and efficiency, and advancing anemia. In many cases where operation is denied, successive *x*-ray examinations will show evidences of new extensions to a higher level of the ileum, evidences which are clear and incontrovertible when the successive series of radiographic films are placed side by side.

Is it the contention of the conservative bloc that these progressive cases represent only the failures of spontaneous recovery and that another larger group having resolved, remain outside the field of observation as cured cases? We know that healing in ileitis is associated with cicatrization (hence the title!), narrowing of the lumen, and frequently with partial obstruction. One would expect under such circumstances to find in mass autopsy statistics, some case or cases of healed and scarred ileitis. Not so, however; I know of no incidental or accidental finding of a healed case of ileitis, either in published reports or in my personal experience at necropsy observations.

Two patients with high ileojejunitis have been under my observation for several years. Because of the extent of the lesion and the widespread involvement of most of the small intestine, mass surgical resection was disallowed and treatment was perforce restricted to medical means. "Medical means" is understood to consist of a non-roughage but abundant diet, vitamin replacement therapy, rest and sunlight. Occasionally nonspecific protein therapy in the form of typhoid vaccine intravenously applied has been utilized. In both of these cases some gain in weight has been observed and some general improvement. However, successive radiographic studies not only fail to show a disappearance of the lesion or a change for the better in the contour of the diseased loops of intestine, but show a continued shrinkage in the transverse diameter of the gut and distinct evidences of cicatrization.

In the last few months I have had another illuminating experience. A young man 23 years of age has had a clear-cut history of ileitis for one year. He had a continuous course of slight fever, cramps, abdominal pain and diarrhea. Three months ago his radiographic studies showed a typical involvement of the last 8 to 10 inches of terminal ileum, with a fistulous tract leading upward to the transverse colon. The patient declined operation and insisted upon a trial of medical therapy. To this I was very glad to accede just because of the question involved as to the final efficacy or inefficacy of such a line of attack.

Having convinced myself for years that brilliant results could and are being achieved in the treatment of ulcerative colitis by typhoid vaccine used as a non-specific protein agent, I found the terms of this experiment very appealing. Therefore the patient was hospitalized, placed on a non-roughage diet, received light therapy, and every third day received intravenously a dose of typhoid vaccine, sufficient to induce a chill and rise of temperature to approximately 102° to 103°F. In ulcerative colitis this method of therapy usually does brilliantly, causing a cessation of diarrhea and pain and rapid change for the better; in addition, relapses can be avoided by continuing the treatment prophylactically with injections at longer and longer intervals.

In the case of this young man with ileitis, the same line of therapy seemed to be associated with success. The diarrhea and cramps ceased, he was more comfortable, became afebrile and gained appetite and weight while in the hospital under close observation. At the end of the probationary period and after the symptoms had ceased, he was again subjected to *x*-ray study. No material or obvious change had occurred in the lesion as compared with the plates taken by the same technique before the institution of therapy. Within three weeks of discharge from observation he was again seized with pain and diarrhea. A recheck of the condition at the Mayo Clinic revealed that not only was the ileitis not cured, but, on the contrary, it showed extension of the lesion into new and higher ileal territory. At operation, three months after institution of medical therapy, an extensive, active, regional ileitis was found with four fistulae leading to various segments of the colon and with distinct involvement of ascending and transverse colon. A radical

and complete resection was now out of the question.

Of course, the failure of conservative therapy in this case (and others) and the attempt to draw conclusions therefrom, may properly be criticized on several grounds. One may object on the score that experiences were insufficient in number, not sufficiently prolonged; that the means of therapy were indiscreetly chosen, or that a black ignorance pervades the field. True, failures to cure, to date, do not exclude the possibility of some future successful plan, nor does one person's ignorance necessarily throw a blight over the better results in more sophisticated hands. One lives to learn, one is willing to sit at the feet of the wise and call him master who will achieve a successful form of conservative therapy for regional ileitis.

3. Is the surgical approach accompanied by danger and suffering?

Yes, like all other abdominal surgery, the result is pain and a risk of life. Both short-circuiting operations (when accompanied by transection of the ileum *above* the lesion) and resections are attended by a considerable mortality, approximately 10 per cent in the palliative procedure, and 15 per cent in the more radical enterprise. But there are compensatory advantages to the greater risk in the latter type of operation. Only half of the short-circuiting operations are attended with success, the other half requiring later resections with a necessarily greater risk. The radical resections are more satisfactory, in at least 90 per cent returning a dividend of perfect health and function. A severe disease must call for severe measures, and regional ileitis is a serious malady. Anyone who has seen the end results of neglected cases, with mass formation, multiple fistulous tracts to the abdominal wall, perineum and adherent hollow viscera, or who has been forced to operate in the presence of subacute intestinal obstruction will have some respect for the intra-abdominal havoc caused by the relentless progress of this granulomatous lesion.

The mortality which accompanies all surgical procedures is, as of this date, magnified by the fact that we are still seeing, in this early first decade of our experience, large numbers of advanced, complicated, and unrecognized cases. The present heavy mortality is in large part due to low-grade perforations, associated local peritonitis, and long-range fistulous tracts, all of which represent late and disastrous complications of what was, in its initial phases, a purely localized and relatively simple pathologic process. Had surgical interference not been denied in the earlier stages, the complicated and dangerous delayed resections would not have been necessitated. To perform a partial gastric resection for an uncomplicated peptic ulcer means a mortality of, let us say 5 to 7, or even 9 per cent, depending upon whose surgical hands are invoked; to perform a resection in the presence of a gastrojejunal ulcer or a gastrojejunocolic fistula means to run up the surgical mortality to 15 or 25 per cent.

If, in the next few years, the profession learns how to recognize ileitis and identify the early phases of the process (a diagnosis which is relatively simple and entirely possible), and if the profession, having cleared up the hang-over of neglected and complicated cases, will meet the newly recognized cases with direct approach and surgical attack, the mortality should proportionately fall to within reasonable limits and should show a most satisfactory situation, both as regards minimal risk and maximal end result.

If there be dissension in the ranks, if there be a failure of minds to agree upon a straightforward radical attack, if there be subversive elements who preach caution when delay is dangerous, the surgical situation will remain less satisfactory than it should be. Clean up the old cases, approach the new cases without doubt or hesitation and the eventual situation should be increasingly satisfactory to both conserva-

tive and liberally-minded members of the profession.

4. ARE RECURRENCES AFTER RESECTION COMMON?

Unfortunately, as the situation now stands, the fact cannot be denied that even in the best of hands recurrences do occur. Whether 7.7 per cent represents the correct figure for recurrence or a slightly higher rate is actually present, is difficult to state at this early period. Suffice it to say that even the minimal rate of 7.7 per cent is serious and assumes a magnitude which defies an attempt to ignore it or to sidestep the issue.

To obviate this situation requires two measures. First, the initial exploratory phase of the operation must be extended to include a most careful search for skip lesions and areas of higher involvement. The resection or the short-circuiting procedure must exclude all infected tissue. The question that arises is: Can the fingers of the exploring surgeon always recognize by tactile sense where the lesion ceases and what is its absolute proximal limit of invasion? Or, can he by observation of the enlarged succulent lymph nodes reliably determine the extent of the involvement? From the number of recurrences I have seen in even the most competent hands, it would appear that the reliable determination of the upper limit of disease is not an easy one, that there may be sub-threshold minimal involvement of mucosa (or lymphatics) defying the senses of touch and sight. If this be the case, then resection or palliative procedure should in the future allow much more safe area, and to be absolutely certain, should be performed at a greater distance from the obvious line of proximal disease. Let no one worry about intestinal function, or postoperative diarrhea, or disturbances of absorption of nutrition and vitamin balance after a more radical resection. The 20 or more feet of small intestine and the 8 or more feet of colon are ample safeguards that denounce penury when determining the limits of resection. Actually we have now so many cases with subtotal colectomies for regional colitis, and so many high intestinal resections without any degree of diarrhea that interferes with perfect health and function, that one should not only call for earlier surgery, but also for bigger and more extensive resections.

It may seem that emanating from one who is supposed to represent the more conservative element of the medical profession, these personal opinions transcend even those of radical surgical enthusiasts on the subject of the treatment of ileitis. I would be willing to go even a step further. On four different occasions I have had the experience of making a clinical diagnosis of ileitis, only to have this opinion reversed by the radiographic report denying the presence of a lesion in the terminal ileum. Nor could I really find fault with the interpretation of the *x*-ray plates, though in possession of all the clinical facts, my eye could see faint fuzziness and indistinctness of mucosal pattern in the terminal ileum that no impartial radiographer could safely admit. These four patients came later to operation and all represented true cases of terminal or regional ileitis. Looking backward, one feels entitled to a righteous regret that the exploratory laparotomy had not been insisted upon at the earliest date of clinical recognition. Herein lies a strong argument for early operation, for higher resections or short-circuitings, and herein probably lies the solution to the regrettable problem of recurrences.

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THE SURGICAL MANAGEMENT OF CHRONIC INTRACTABLE ULCERATIVE COLITIS

HENRY W. CAVE

Attending Surgeon, Roosevelt Hospital

NEW YORK CITY

IT has been only within the last ten years that radical surgical measures have been employed to any extent in the cure of chronic ulcerative colitis. We all know that for many years appendicostomy, cecostomy, and ileostomy have been considered curative procedures, but in the light of our present knowledge these are thought to be of little benefit. Previously, the entire diseased large bowel was rarely removed, and only in one or two instances by any individual surgeon. Howard Lilienthal[1] of New York, in 1899, was one of the first American surgeons deliberately to perform colectomy for what was previously diagnosed a chronic intractable case of this disease in a young woman 25 years of age. The outcome was successful and the patient is still alive.

Failure of medical measures when this disease has reached the intractable stage has led to surgical intervention in an increasing number of cases. No clinician of wide experience with this disease at the present time is willing to accept the term "cure." It is true that not infrequently conservative measures have been followed by temporary improvement, but unfortunately the improvement has not been sustained. It is unlikely that after any given period of freedom from activity the disease will not exhibit a recrudescence. Clinicians generally are now admitting that many patients have been lost in the past because radical surgical measures were denied them.

INDICATIONS FOR SURGERY

The indications for surgery can be based fairly accurately on the clinical picture: (1) the effects of toxemia and sepsis; (2) local symptoms referable to the bowel and by the use of roentgenograms; (3) fistulae, sinuses, hemorrhages and perforations, either subacute or chronic, and strictures; and (4) where there exists a diffuse polyposis with or without malignancy.

During the past three years, we have had what we consider an unusual opportunity to study intensively many patients suffering from ulcerative colitis. A special thoroughly equipped laboratory was established for the sole purpose of investigating this and allied diseases. So far, many of these patients have proved temporarily amenable to medical treatment. Some have become surgical responsibilities. One hundred and sixty patients with this disease have been treated in our institution. Twenty-nine have been subjected to surgery, and it is from this experience that certain deductions have been obtained which we believe worthy of presentation. The following operations have been performed on twenty-nine patients:

Ileostomy	21
Ileosigmoidostomy	3
Partial colectomy with low transverse colostomy	2
Partial colectomy with removal of rectum	2
Colectomy	11
Colectomy with removal of the rectum	3

There are four types of the disease: (1) mild cases, at least temporarily arrested and perhaps cured by medical management alone; (2) acute fulminating, frequently fatal; (3) chronic continuous; and (4) chronic with remissions. Confusion exists in the minds of many observers as to when the stage of intractability has been reached, and there has been a diversification of opinion up to the present as to the proper time for surgical intervention. These two problems appear often difficult of solution,

yet must be faced and solved if successful outcome is to be expected. It is considered necessary that all patients suffering from this disease should be meticulously studied, and some over a prolonged period of time. In the acute fulminating forms, prolonged study wastes time, increasing morbidity and mortality. Needless to say, vitamin and other deficiency states should be rectified and all foci of infection eradicated. Considerable reliability can be placed on comprehensive roentgenograms, and particularly on proctoscopic examinations (for 90 per cent originate in the rectum).

The *x*-rays show characteristic shortening of the entire colon, narrowing of the lumen, mucosal destruction and absence of haustral markings. The normal angulations at the flexures tend to approximate right angles. The barium enema demonstrates a rapidly filling colon with hyperirritability of the involved segments. Such a picture is a clear indication of the removal of the diseased colon.

PREOPERATIVE PREPARATION

The preoperative preparation of these patients is of the utmost importance. In fact, it is of more importance than in almost any group of surgical patients that we encounter. Thin, emaciated, dehydrated, anemic, septic and forlorn, they present a pitiful picture. For the most part, most of these individuals that come to surgery have been carefully investigated by the clinicians and their deficiencies corrected. Even so, we consider essential intravenous glucose and saline twice daily, transfusions if indicated, low residue diet, gentle cleansing colonic irrigations with warm saline, and for two days prior to operation, lead and opium pills and paregoric in order to shrink the bowel, thus simplifying technical maneuvers.

ANESTHESIA

These patients seem to tolerate avertin, gas, oxygen, and ether. We have found novocaine, preferably pontocaine and nupercaine, as spinal anesthetics eminently fitting for prolonged continuous action, thus affording relaxation at the second stage when the colon is removed.

THE SELECTION OF OPERATIVE PROCEDURE

We feel justified in emphatically stating that whatever procedure is chosen, and no matter how many stages are found necessary, all of the diseased bowel should be removed, otherwise a cure cannot be hoped for. Due to the markedly debilitated condition of these individuals, two, three, and even four stages may make for added safety.

Ileostomy is the first stage in 75 per cent of the cases. It is important that the terminal ileum be divided in an area which is not involved, whether it be 6 inches from the ileocecal valve or 3 feet from the ileocecal valve. The ileostomy should be placed on the anterior abdominal wall at a point where it can be cared for easily. The proximal loop should be drawn well out, 3 or 4 inches if possible, and not sutured in any manner to the anterior abdominal wall, for no matter how carefully placed the sutures are through the serosal surface, in coughing or straining after operation, leaks may occur and annoying fistulous openings result. We have found that ileostomies placed too close to the midline predispose to intestinal obstruction, on account of loops of small intestine encircling it. Therefore, a McBurney incision is chosen and the mesentery sutured to the lateral peritoneal reflection to prevent loops of small bowel from being caught and becoming obstructed. We believe the practice of exploring the abdomen at the time of the performance of ileostomy a pernicious one. It is frequently safer to bring out the distal end as a mucous fistula rather than to turn it in and drop it back, as was originally advocated by Rankin. Ileostomy is accompanied by a relatively high mortality, due, I believe, principally to the fact that these patients are brought to surgery too late. It is an undeniable fact that ileostomy alone has, in a few authentic cases, proved not merely palliative but curative.

Ileosigmoidostomy has been used as a first stage procedure in a small group of individuals where the rectum had been previously determined free of the disease. When the left colon and rectum are alone involved and it has been accurately proved that the process has become stationary, transverse colostomy is justified as a first stage procedure. Care should be taken that the colostomy in the transverse colon is placed in a healthy segment of the bowel. Over 90 per cent of the patients in our series, following ileostomy, have shown a tremendous gain in weight, due to diversion of the fecal stream. Four to six months is usually allowed before the second stage of subtotal colectomy is contemplated. We have performed subtotal colectomy eleven times, with one death. A most striking feature of this seemingly extensive operation has been the mildness of the postoperative reaction, as well as the fact that all of our wounds have healed per primam.

The second stage of subtotal colectomy we have carried out through a long left paramedian incision. There are two points during this maneuver which have seemed somewhat difficult: (1) starting the mobilization of the distal terminal ileum, cecum, and ascending, and (2) the division of the splenophrenocolic ligament. Careful hemostasis must be effected, and warm moist pads used to protect the exposed coils of intestine, diminishing the chance of rapid fall in blood pressure. We have made it a practice to separate the omentum from the transverse colon for the reason that it simplifies the removal of the colon and preserves the omentum for the purpose of covering raw areas. In mobilizing the right colon, it is well to identify the right ureter, particularly in its lower half, and the third portion of the duodenum higher up, which may be easily injured if care is not taken in thoroughly exposing it. A fall of blood pressure not infrequently follows the division of the middle colic artery, and it is at this stage where we have been forced to immediately resort to transfusion. As has been stated, the most difficult part of the entire procedure is adequate exposure and division of the splenophrenocolic ligament. When this has been accomplished, the left colon is easily mobilized, and we have had but little difficulty in securely closing the stump of the sigmoid colon with several layers of interrupted silk sutures. If the bowel at this level is friable, it is safer to bring this out as a mucous fistula instead of attempting closure. We have made a practice at this second stage of peritonealizing all raw surfaces. It does prolong to some extent the operation, but we feel it also minimizes the chance for the formation of adhesions.

The third stage is carried out by the combined abdominoperineal resection some four to six months later, when there has usually been an appreciable gain in weight and the patient has been rehabilitated. After ileostomy, after subtotal colectomy, and after the third stage of combined abdominoperineal resection of the rectum, transfusion has proved beneficial. In the poor risk patient, four stages are of necessity employed; the second stage may stop with removal of the right colon and a part of the transverse colon, the third stage consisting of removal of the remainder of the transverse colon, splenic flexure, and descending colon.

COMPLICATIONS

The most frequent complication following the operations for the cure of this disease is peritonitis. Perforation of the colon has occurred, even though diversion of the fecal stream has been accomplished with ileostomy. Where the disease is far advanced, strictures and massive hemorrhages occur, even though the fecal current has been sidetracked. Ileus is not an infrequent complication.

Of twenty-nine patients sent to surgery, five died, giving an operative mortality of 17.2 per cent.

CONCLUSIONS

1. Surgery should be delayed until two factors have been adequately evaluated:

(1) the response to conservative treatment, and (2) the extent and distribution of permanent damage to the colon.

2. As yet, it is difficult to define the criteria for determining operability.

3. Operative maneuvers are based upon and determined by the situation of permanent damage to the colon.

4. Ileostomy has been in the past accompanied by a high mortality rate, due to the fact that the clinicians have been reluctant to subject these patients to surgery until in the late stages, and also to the fact that they have become rapidly dehydrated due to loss of fluids and chlorides through the ileostomy.

5. Staged procedures are carefully planned, adequate time elapsing between the stages to insure satisfactory rehabilitation.

6. Of 160 patients studied, twenty-nine were subjected to surgery with five deaths, or a mortality of 17.2 per cent.

7. Following removal of the colon and rectum, the ileal stoma takes on the characteristics of the rectal pouch. The stools become more solid and are better formed.

8. These patients gained from 40 to 50 pounds after removal of the diseased colon.

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The simplest and in most cases the best method of treatment of a benign rectal stricture is dilatation under anesthesia with or without intraluminal incision.

GASTROJEJUNAL ULCER: A STUDY OF 155 CASES

WALTMAN WALTERS, M.D. AND O. THERON CLAGETT, M.D.

Division of Surgery, The Mayo Clinic — Assistant Surgeon, The Mayo Clinic

ROCHESTER, MINNESOTA

THERE is probably no surgical subject that has occasioned as much thought, research and controversy or as voluminous a literature as has gastroduodenal ulceration and its complications. In spite of the tremendous amount of work which has been done on the subject, there are still many problems which are as yet not satisfactorily solved, and of these, gastrojejunal ulceration is one of the most important. Fortunately, gastrojejunal ulceration is not a frequent complication of the surgical treatment of gastroduodenal ulcerative disease, but it is a complication of major importance.

ETIOLOGY

The cause of gastrojejunal ulceration is not definitely known. It has been suggested that the condition might be due to errors in surgical technique, to unabsorbed suture material used in the anastomosis or to pressure of the clamps used. It is now generally agreed, however, that these factors are probably not of great importance and that gastrojejunal ulceration is probably due to the same factor that produced the original gastric or duodenal ulceration, namely, a lowered tissue resistance to gastric secretion. The development of gastrojejunal ulceration indicates that the chemical changes in the acidity of the gastric contents and the changes in motility that are the result of the gastrojejunal anastomosis have failed to control the ulcer-forming tendencies.

Ochsner and his associates have suggested that according to our present knowledge the most important factors in the causation and persistence of peptic ulcer are: (1) an inherited constitutional predisposition to form ulcer, that is, an ulcer diathesis; (2) a tissue susceptibility to ulceration; and (3) an increased acidity of the gastric contents. There are undoubtedly other factors which may contribute to the development of ulcers, but these outlined by Ochsner are probably the most important. Of all factors, the ones that are most amenable to control are increased gastric acidity, pylorospasm and decreased emptying time of the stomach. The medical therapy of ulcer attempts to control acidity by frequent feedings and alkalis. Surgically, acidity is controlled either by gastroenterostomy or partial gastrectomy. Both operations bring about dilution and neutralization of gastric acids with alkaline duodenal, pancreatic and biliary secretions, and the latter results in removal of a portion of the acid-stimulating and acid-secreting portion of the stomach. Relief of pylorospams and increase of the emptying time of the stomach occur after partial gastrectomy, gastroenterostomy and pyloroplasty. However, tissue susceptibility to recurring ulceration is a factor which at present is difficult to control. It is unfortunate that there is no method of determining predisposition or tissue susceptibility to ulceration. If one was able to measure this factor one would be able to determine in which cases of ulcer radical methods of treatment, such as gastric resection, would be required and in which cases the patients could be satisfactorily treated by more conservative methods, such as gastroenterostomy, pyloroplasty and gastroduodenostomy.

INCIDENCE

It is generally agreed that gastrojejunal ulceration is essentially a complication of the surgical treatment of duodenal ulcer. However, the condition can develop after any surgical anastomosis of the stomach

to the jejunum. Although gastrojejunal ulceration may develop subsequent to gastroenterostomy for gastric ulcer, it does so rarely. Seldom does it develop after extensive partial gastrectomy and more seldom still does it develop after palliative gastroenterostomy for inoperable carcinoma of the stomach.

It has been our experience at the Mayo Clinic that gastrojejunal ulceration has rarely complicated surgical treatment of gastric ulcers. In 1930, Balfour[2] reported that gastrojejunal ulceration did not occur in any of a series of 100 cases of gastric ulcer in which the patients were treated solely by gastroenterostomy. In a review of a recent series of 252 cases of gastric ulcer in which various surgical procedures were employed, we found that gastrojejunal ulcer did not develop subsequently in a single case. On the other hand, Wright[34] in England has reported that gastrojejunal ulceration occurred in 10.45 per cent of 884 cases of gastric ulcer in which gastroenterostomy was performed. We find it difficult to account for this incidence since such a high incidence has not been reported by any other investigators so far as we know.

There is also a rather marked discrepancy in the incidence of gastrojejunal ulceration after gastroenterostomy for duodenal ulcer, as reported by various investigators. Balfour,[2] in 1930, reported an incidence of 3.2 per cent in a series of 500 cases in which duodenal ulcer was treated by gastroenterostomy. Heuer, in 1935, reported an incidence of 3 per cent in 1,559 cases in which operation was performed by seventeen different surgeons. In an unselected series of 744 cases of duodenal ulcer collected and reported by Luff, in which the operation was performed by many surgeons (members of the British Medical Association), the incidence of gastrojejunal ulcer was 2.8 per cent. Walton has estimated the incidence at 3 to 4 per cent, Kelly at 2 to 5 per cent, and St. John at about 7 per cent. On the other hand, Wright[34] found an incidence of 8.49 per cent in 2,734 cases of duodenal ulcer in which gastroenterostomy was performed. Lahey estimated the incidence at 15 per cent, Ogilvie[23] at 20 per cent, Lewisohn, at 34 per cent and von Haberer, Finsterer,[7] Berg and Strauss at from 8 to 30 per cent. Lorenz,[9] who, with Schur, was one of the first, if not the first, to advocate gastroenterostomy as a routine method of treatment of duodenal ulcer, reported the incidence of gastrojejunal ulcer to be 10 per cent in his cases in which this operation was performed for duodenal ulcer.

There is almost as great a discrepancy in the various estimates of the incidence of gastrojejunal ulceration after partial gastrectomy. Apparently, gastrojejunal ulceration rarely occurs after partial gastrectomy is performed for gastric ulcer. In the experience of one of us (Walters) it has not been observed in cases in which the gastric ulcer was benign and two-thirds or more of the stomach was removed. All writers agree, however, that there is a definite incidence of gastrojejunal ulceration after partial gastrectomy for duodenal ulcer. In 1928, Balfour[1] reported a series of twenty-eight cases in which recurrent ulceration occurred after partial gastrectomy, and in the same year Hurst and Stewart collected more than eighty similar cases. Starlinger reported recurrent ulceration in 0.5 per cent of a collected series of 2,500 cases in which antecolic resection was performed for duodenal ulcer and in 0.6 per cent of 14,200 cases in which postcolic resection was performed. On the other hand, Sawkoff in a recent review of Russian literature reported a series of 126 cases in which gastrojejunal ulceration occurred after primary partial gastric resection was performed for duodenal ulcer, an incidence of 4.32 per cent, a figure comparable to the usually accepted incidence of gastrojejunal ulceration after gastroenterostomy. Wright[35] has reported that the incidence of gastrojejunal ulceration was 2.75 per cent in a series of seventy-seven cases in which a posterior Polya resection was performed for duodenal ulcer. Statistics from one of the large hospitals in the eastern part

of the United States showed that gastrojejunal ulceration occurred in 3.1 per cent of cases of duodenal ulcer in which a Polya resection was performed.

Probably at least a part of the variations of these estimates is due to the so-called geomedical variation of types of lesions and by the part played by racial factors in these differences. This factor has been commented on by Snell and one of us (Walters), and by von Haberer and Schittenhelm.[9] Another factor of importance is the amount of stomach removed by the resection. There is no doubt that some recurrences are due to the failure to perform a sufficiently extensive resection. Finsterer[8] said that in most cases the ulceration is due to this factor. Most authorities agree that about two-thirds of the stomach should be resected. Others feel that removal of three-fourths or four-fifths of the stomach is necessary.

A third factor is the postoperative regimen. Some authorities feel that if an extensive resection is performed there is no necessity for instituting any type of postoperative dietary regimen. Others feel that failure to emphasize this factor is responsible for some recurrences. In a recent visit to some of the surgical clinics in Belgium, one of us (Walters) was impressed with the very extensive partial gastrectomy performed for duodenal ulcer; approximately four-fifths of the stomach was removed routinely. Recent literature indicates that partial gastrectomy for duodenal ulcer is more productive of jejunal ulceration than was formerly suspected. Advocates of conservative operation have called attention to this fact and have pointed out that the possibility of recurrence of ulceration after gastric resection must be carefully considered before subjecting a patient to the added risks of partial gastrectomy. Practically all writers agree that partial gastrectomy is much less productive of jejunal ulcer than is gastroenterostomy, but some still doubt if the advantages of resection are worth the higher risk, especially since resection does not leave the avenues of surgical retreat, in case of recurrent ulceration, that are available if gastroenterostomy has been performed. Furthermore, in a definite percentage of cases in which extensive partial gastrectomy has been performed, although the patient may not have a recurring ulcer, gastritis in the upper part of the stomach may continue to exist and cause some dyspeptic symptoms (Fig. 1), and in another group of cases vagotonic symptoms, such as sweating and faintness, which occur after the ingestion of food and cause the patient to spend a short time in the recumbent position, may be a source of annoyance.

The following case is interesting in view of the finding of gastritis at necropsy.

A man, aged 51 years, first came to the clinic on April 25, 1938. He stated that in 1932 he had been operated on for closure of a perforating duodenal ulcer. A gastroenterostomy had been performed in 1930 and six months later symptoms of ulcer had recurred. Roentgenologic examination did not reveal the gastroenteric stoma but it did disclose a duodenal ulcer with a deep crater. The patient also had angina pectoris. On May 2, 1938 a gastrojejunal and a duodenal ulcer were removed and a partial gastrectomy was performed. The patient made an excellent recovery and was well until February 24, 1939, when he began to have intermittent chills and fever. The patient returned to the clinic on March 10, 1939, at which time a diagnosis of meningitis was made. In spite of all medication the patient died on April 14, 1939. Necropsy revealed acute cerebrospinal meningitis, bronchopneumonia and gastritis in the remaining portion of the stomach (upper third following posterior Polya resection).

It is difficult to account of the difference in recorded observations of men interested in the problem of gastrojejunal ulceration. Eggers raised the following question: "Are the proponents of conservative surgery less keen observers or are they dealing with a different kind of case?" He expressed the opinion that the discrepancy results largely from the type of patients selected for opera-

tion. He pointed out that the age, sex, and race of the patient, his environment, temperament and diet all have an important bearing on the behavior of an ulcer and should guide the type of therapy to be carried out. He attributed most of the failures of gastroenterostomy to inadequate consideration of these factors and the performance of gastroenterostomy without proper indication. He deplored the sacrifice of half or more of the stomach in the treatment of an ulcer which is anatomically and physiologically separated from the stomach. He emphasized that failure to institute a medical regimen after gastroenterostomy is responsible for many recurrent ulcers.

FIG. 1. Gastritis of the upper third of stomach, noted at necropsy approximately one year following extensive partial gastrectomy for gastrojejunal and recurring perforating duodenal ulcers.

At least a part of the discrepancy in reported figures can also be accounted for by the fact that it is impossible to set an arbitrary time limit for cure, as is done, for example, in carcinomatous lesions, where a five-year period without recurrence is accepted as a cure. Gastrojejunal ulceration can develop within a few days or may not develop for many years. Hunt has recently reported a case in which an ulcer developed twenty-seven years after gastroenterostomy was performed. This factor makes it difficult for any investigator to determine accurately the ultimate success or failure of any operation for duodenal or gastric ulcer. At the same time operations that have relieved distress for many years cannot be regarded as complete failures. May not the recurring ulcer have developed after some unknown factor has lowered tissue resistance to gastric secretion and is it not possible that this factor has been in abeyance for the many years during which the patient has been symptom-free?

In our experience, gastrojejunal ulceration is an infrequent complication of the surgical treatment of duodenal ulcer and rarely develops subsequent to the surgical treatment of gastric ulcer. As regards the frequency of this complication, we feel that

the true incidence is probably much nearer to the low estimates mentioned previously than it is to the higher ones. When gastrojejunal ulceration occurs, it is a distressing complication and yet when surgical treatment is instituted early, disconnection of the gastroenteric anastomosis and removal of the gastrojejunal ulcer with a partial gastrectomy practically always prevent further ulceration in the jejunum and the risk of the operation is not great in the hands of the experienced gastric surgeon.

Our present viewpoint is that partial gastrectomy offers the greatest possible protection against recurrent ulceration. The difficulty lies in differentiating those cases of duodenal ulcer in which the added risk of this more radical procedure is justified from those in which gastroenterostomy will give satisfactory results with less risk. As long as we lack means of measuring the genetic factors of ulcer, tissue susceptibility to ulceration and predisposition to ulcer formation we must depend on a careful clinical study and analysis of each case, considering especially the age, sex, race, occupation and type of individual, the values for the acidity of the gastric contents and the results of roentgenologic and gastroscopic examination. Until the cause is discovered and more effective methods of control than we have at present are found, the incidence of gastrojejunal ulceration can probably best be controlled by emphasizing the necessity of drawing surgical indications more sharply and by selecting for each individual that type of surgical procedure which experience has shown will promise the best end results in each particular case. In other words, one should fit the operation to the patient and the lesion rather than use routinely the same type of operation in every case, regardless of the characteristics. It has been our experience that in cases in which active middle-aged men have a high gastric acidity and perforating or bleeding type of lesions, the operation of choice is usually primary extensive partial gastrectomy, provided it can be done safely. Yet, in many such cases in which the extent of the duodenal ulceration or the condition of the patient has not seemed to warrant the inincreased risk of partial gastrectomy, a gastroenterostomy has been followed by excellent results and the ulcer has not recurred. In the case of older individuals, women, and patients who have a low gastric acidity or large perforating or obstructing lesions, the results of gastroenterostomy are so satisfactory and the incidence of gastrojejunal ulceration so small that we see no reason for assuming the greater risk of more radical procedures. If gastrojejunal ulceration does take place and the patient is reoperated upon early, the risk of the operation will frequently be less than it would be if a primary partial gastrectomy and duodenectomy with removal of the duodenal ulcer had been performed for the original duodenal ulcer. The duodenal ulcer will be found to have healed and its removal and the accurate closure of the duodenum will not be such a great problem and the risk will not be as great as when the duodenal ulcer was large and active and its removal would have left little duodenum to suture.

It has been our experience that gastroduodenal ulcerative disease occurs about four times as commonly among men as it does among women. Gastrojejunal ulceration is even more predominantly a disease of the male sex. In some large series of cases, the condition has occurred about seven to ten times as frequently among men as it has among women and in our series of 155 consecutive cases in which operation was performed for gastrojejunal ulcer at the clinic there were only three women; the ratio of men to women, therefore, was about 50:1.

Gastrojejunal ulceration may develop while the patient is still in the hospital recovering from the gastroenterostomy, although this is a rare occurrence; on the other hand, it may not develop for many years. The extremes of development in our series were twelve days and eighteen years. Other surgeons have had a similar experi-

ence. In our series of cases in which gastrojejunal ulceration developed, the average duration of good health and freedom from ulcer symptoms following gastroenterostomy was 2.98 years. In the majority of cases the patients were between 30 and 50 years of age.

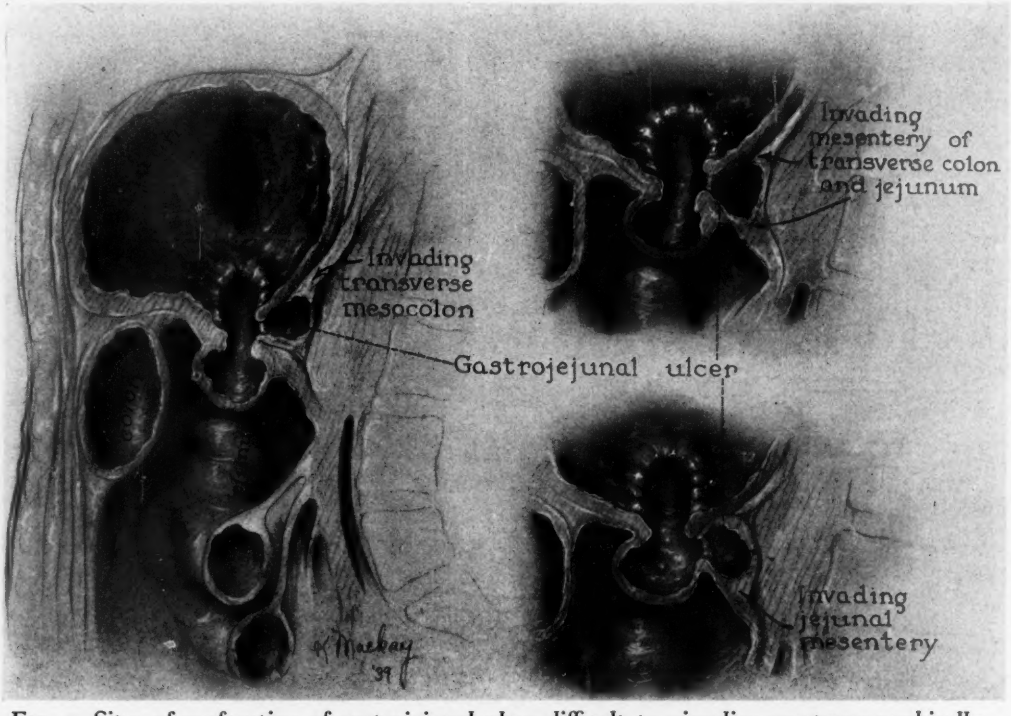

FIG. 2. Sites of perforation of gastrojejunal ulcer difficult to visualize roentgenographically.

DIAGNOSIS

The diagnosis of gastrojejunal ulceration is not difficult as a rule. The symptoms are, in many respects, similar to those of duodenal or gastric ulceration. There is a gnawing, hunger pain which comes on between meals and occasionally awakens the patient at night. The pain may be relieved by food or alkalis, but it may not be as amenable to control as was the distress of the original lesion. The pain may be epigastric, but frequently has shifted below and to the left of the site of the original distress. Extension of the pain posteriorly is common and may be very severe, especially if the ulcer has perforated against the mesocolon or to the mesentery of the jejunum. (Fig. 2.) Sometimes, when subacute perforation of the ulcer has occurred, extension of the pain to the left groin suggests a lesion of the left kidney or ureter. The periodicity of distress, which was characteristic of the original ulcer, may not be as definite in case of secondary ulcer and the periods of relief are often incomplete. On the other hand, gastrojejunal ulceration may be symptomatically silent until a sudden hemorrhage calls attention to the presence of ulceration. Hemorrhage is a very frequent complication of gastrojejunal ulceration. Gross hemorrhage occurred in 52.9 per cent of our series of cases. Vomiting is also common; in 49.7 per cent of our cases there was a history of this symptom. Perforation of the gastrojejunal ulcer into the transverse colon with development of a gastrojejunocolic fistula has been estimated to occur in from 9 to 19 per cent of cases of gastrojejunal ulcer. In the period in which the 155 consecutive cases of gastrojejunal ulcer were observed at the clinic twenty-three cases of gastrojejunocolic fistula were observed.

Although roentgenologic studies are of considerable value and should be carried out routinely in cases of suspected gastro-

jejunal ulceration, it should be pointed out that they cannot be expected to demonstrate ulceration in every case in which ulceration is found on surgical exploration. In competent hands, however, roentgenologic accuracy is very satisfactory. Dr. B. R. Kirklin reported that the roentgenographic findings were positive in fifty-three, or 91.4 per cent, of fifty-eight cases of gastrojejunal ulcer in which operation was performed at the clinic during 1938. In seventeen, or 29.3 per cent, of these cases the roentgenographic report was jejunitis or a poorly functioning gastroenteric stoma and in thirty-six, or 62 per cent, it was gastrojejunal ulcer. Gastrojejunal ulcer was reported in thirty-seven cases on roentgenographic examination and at operation gastrojejunal ulcer was found in thirty-six of these cases. In the other case the surgical diagnosis was obstruction of the gastroenteric stoma. In only five, or 8.6 per cent, of fifty-eight cases, was the roentgenographic report negative. In other words, although roentgenoscopy failed to demonstrate a definite ulcer crater in 38 per cent of cases (Fig. 2) in which gastrojejunal ulceration was found at operation it disclosed definite abnormality of the appearance and function of the gastroenteric stoma in 91.4 per cent. A roentgenologic diagnosis of gastrojejunal ulceration was extremely reliable, as an ulcer was found at operation in 97.3 per cent of the cases. Kelly has found in his experience that roentgenography is not always a dependable diagnostic procedure in gastrojejunal ulcer as the irregularities caused by the gastrojejunal anastomosis make visualization of the involved region difficult, especially if the ulcer crater is small.

Gastroscopy is becoming an increasingly valuable addition to our diagnostic armamentarium. It is not indicated as a routine procedure and in no way infringes upon the place of roentgenologic examination in the diagnosis of gastrojejunal ulcerations, but as an adjunct to other methods of diagnosis it is extremely valuable. It is especially indicated and of value in cases in which the roentgenologic findings are indefinite or negative, but in which the clinical findings suggest the presence of gastrojejunal ulceration. Moersch said that it is frequently possible to look directly into the gastroenteric stoma with the gastroscope and even in cases in which this is impossible there may be other direct visual evidence of ulceration, inflammation or malfunction of the anastomosis.

In the absence of any reliable diagnostic or laboratory procedure, the diagnosis of gastrojejunal ulceration must and should depend on a careful analysis and evaluation of all the information that can be gained from the history and physical findings and from the laboratory, roentgenologic and gastroscopic investigations. Surgical treatment should be advised when the diagnosis is made. Gastrojejunal ulcer is rarely healed under a medical regimen.

SURGICAL TREATMENT OF GASTROJEJUNAL ULCERATION

The development of gastrojejunal ulceration according to our present conception of the disease indicates two things: first, that the patient has a definite predisposition to the development of ulceration or a tissue susceptibility to ulceration, and, second, that the ulcer-forming tendencies of that individual have not been adequately controlled by the procedure that has been performed whether it has been gastroenterostomy or gastric resection. An individual who has a gastrojejunal ulcer is an "ulcer former," and in most instances a surgical procedure which will permanently alter the gastric physiology and permanently control the gastric acids is imperative if recurrent ulceration is to be prevented. The procedure which will most satisfactorily meet these requirements has in our experience been partial gastrectomy of the posterior Polya type, if gastrojejunal ulceration occurs after gastroenterostomy, and more extensive gastric resection if a partial gastrectomy has been performed previously.

Disconnection of Gastroenteric Anastomosis Followed by Gastroduodenostomy or Pyloroplasty. A disconnection of the gastroenteric anastomosis, excision of the ulcer, closure of the openings in the stomach and jejunum, and either a pyloroplasty or a gastroduodenostomy have been procedures frequently used in the surgical treatment of gastrojejunal ulceration, based on the premise that they are less radical procedures than partial gastrectomy and yet offer a considerable measure of protection against recurrence of ulceration by reason of the regurgitation of duodenal contents through the stoma into the stomach, by relief of pylorospasm and by increasing the emptying time of the stomach. Time has shown the relative inefficiency of this procedure. In our series of 155 consecutive cases in which operation was performed for gastrojejunal ulcer this procedure was carried out in sixty-eight cases. Seven patients died postoperatively, a mortality of approximately 10 per cent. We were unable to get information concerning twelve patients in this group. There was definite recurrence of duodenal ulceration in twenty, or in 40.8 per cent, of the cases in which we were able to obtain follow-up data. Recurrence was found by reëxamination at the clinic or by operation in these twenty cases. In nine of these twenty cases partial gastrectomy has been performed at the clinic or elsewhere. One patient now has roentgenologic and clinical evidence of jejunal ulceration after partial gastrectomy. Five additional patients have had recurrent symptoms of gastrojejunal ulceration and gross hemorrhage subsequent to disconnection of the gastroenteric stoma and performance of gastroduodenostomy, and may be presumed to have recurrent duodenal ulceration. Seven patients have had definite recurring symptoms but no bleeding. Nine patients have a moderate amount of distress, but have gotten along rather well with medical management. Only eight patients have obtained entirely satisfactory results.

Removal of Gastroenteric Anastomosis. Disconnection of the gastrojejunal anastomosis and restoration of normal gastrointestinal continuity without a plastic procedure on the outlet of the stomach were carried out in twenty-five cases with a mortality of 8 per cent. We were unable to trace two patients. Seven, or 33.3 per cent, of the twenty-one patients who could be traced have had recurrence of duodenal ulceration. Three of these seven patients had undergone a partial gastrectomy. Four patients have had symptoms that suggest recurrence, but ulceration has not been proved. Ten patients have gotten along very satisfactorily without any distress of consequence.

Plastic Procedures on the Gastroenteric Stoma. A plastic procedure on the gastrojejunal stoma without disconnection of the anastomosis was performed in four cases. One patient died, one obtained a satisfactory result and the other two had a definite recurrence of gastrojejunal ulceration.

Disconnection of Posterior Gastroenteric Anastomosis and Establishment of an Anterior Gastroenteric Anastomosis and Enteroanastomosis. This procedure was carried out in four cases. One patient died, and there was definite recurrence of gastrojejunal ulceration in the remaining three cases.

Disconnection of Gastroenteric Anastomosis and Performance of Billroth I Resection. A disconnection of the gastroenteric anastomosis followed by excision of the ulcer, closure of the opening in the jejunum and a Billroth I type of resection was performed in six cases. Three patients obtained very satisfactory results. There has been definite recurrence of duodenal ulceration in two cases and the symptoms suggest recurrence in the third case.

Disconnection of Gastroenteric Anastomosis and Performance of Anterior Polya-Balfour Resection. A disconnection of the gastroenteric anastomosis followed by an anterior Polya-Balfour type of resection with enteroanastomosis was performed in seven cases. Two patients died postopera-

tively. There has been definite evidence of recurrent gastrojejunal ulceration on examination at the clinic in two cases, one patient has symptoms suggesting recurrence and two patients are in excellent health.

Disconnection of Gastroenteric Anastomosis and Performance of Posterior Polya Resection. This procedure was carried out in thirty-nine cases. Two patients died; therefore, the surgical mortality was 5.1 per cent. Three could not be traced. There has been definite recurrence in four, or 11.7 per cent of the cases in which the patients could be traced. Three of these four patients have since had second resections of the stomach performed. Three patients have had considerable distress suggesting recurrent ulceration but no bleeding and no definite evidence of ulceration. Twenty-seven, or 79.4 per cent, of the patients who survived the operation have obtained satisfactory results.

Miscellaneous Procedures. In one case the gastrojejunal ulcer was so large and the condition of the patient so poor that a jejunostomy was done for feeding, in the hope that placing the gastrojejunal anastomosis at rest would decrease the size of the ulcer. In spite of this the patient died.

In another case there was a very large gastrojejunal ulcer with impending perforation to the colon. The mass was so large that it seemed advisable to resect the portion of the jejunum and colon containing the ulcer, restore the continuity and close the opening in the stomach. This patient we have been unable to trace.

COMMENT

The various surgical procedures, such as disconnection of the gastroenteric anastomosis alone or combined with a plastic procedure on the outlet of the stomach, various plastic procedures on the gastrojejunal stoma, disconnection of the posterior gastroenteric anastomosis and establishment of an anterior gastroenteric anastomosis, have given unsatisfactory results in a majority of cases of gastrojejunal ulcer. Yet in a definite percentage of cases in each group good results were obtained. Patients who have gastrojejunal ulcer are "ulcer formers" and as such require a surgical procedure that will control their ulcer-forming tendencies. In many cases, however, it must be pointed out that the patients were in rather poor condition and the conservative procedures carried out were often those of necessity rather than those of choice, the patient's condition seeming to prohibit partial gastrectomy which might, to a great extent, have prevented recurrent ulceration. In such cases we now believe that the operation should be divided into two stages; the first stage should include the treatment of the gastrojejunal ulcer and the second stage, which should be performed when the patient is in good condition, should attempt to control the patient's ulcer-forming tendencies by means of partial gastrectomy. The only objection to this is that if recurrence of the duodenal ulcer takes place after disconnection of the gastroenteric anastomosis it usually shortens the duodenum and makes removal of the ulcer and closure of the short stump of duodenum hazardous.

It is readily apparent that extensive partial gastrectomy of the posterior Polya type has given the best results in selected cases, and, interestingly enough, with the lowest risk in the treatment of gastrojejunal ulcers. It is the only procedure which can be depended upon to decrease adequately the concentration of hydrochloric acid in gastric secretion and hence remove the exciting factor whose effect upon the sensitive jejunum is less likely to produce recurring ulceration than if reduction and dilution of gastric acidity had not been obtained. The operation may be difficult. It is best and most safely performed by those accustomed to performing difficult gastric operations. The resection should include the pylorus and two-thirds or three-fifths of the stomach if gastric acidity is to be adequately reduced.

The importance of including the pylorus in resections of the stomach for duodenal ulcer is not generally appreciated. However, there is extensive experimental and clinical evidence which shows conclusively that this is an essential part of the operation. Edkins was probably the first to point out that the pylorus in some way controlled the acid secretion of the stomach. He found that peptones and other meat extracts acted on the mucous membrane of the pylorus to produce a hormone which led to an increased flow of acid gastric juice. Wilhelmj and his associates have confirmed this observation and have concluded from their studies that after removal of the pylorus, owing to removal of its specific stimulating influence, the quantity of acids in the gastric contents was definitely reduced. Lorenz and Schur have also shown that removal of the pylorus decreases the production of hydrochloric acid and lessens the probability of recurrent ulceration. Ogilvie[24] noted that in cases in which he did not resect the pylorus the curve representing the gastric acidity was high postoperatively as compared to those cases in which he included the pylorus in the partial gastric resection. In six of twenty-two cases in which the pylorus was not resected he reported that further operation was required for jejunal ulcer while in 100 cases in which partial resection, including the pylorus, was performed there was no recurrent ulceration. Friedemann, in a review of a series of 2,250 cases in which partial gastric resection was performed, noted a recurrence of ulcer in 4 per cent of his early cases and in only 0.5 per cent of his later cases in which he did a more radical operation, including resection of the pylorus in every case. Spath and Friedemann have both reported recurrence after partial gastric resection, but subsequent removal of the pylorus lowered the gastric acidity and healed the ulcer.

Removal of the pylorus adds somewhat to the difficulty of the operation since it requires freeing of the duodenum. In some cases of perforating duodenal ulcer this is quite difficult but we feel that it should be a part of every partial gastric resection for duodenal ulcer or recurring ulceration. Some of the difficulties of closure of the duodenum can be obviated by removing the mucosa of the pylorus without the muscle, as suggested by Engel.

SUMMARY

Gastrojejunal ulceration is an uncommon complication of the surgical treatment of gastroduodenal ulcerative disease. It is essentially a complication of the surgical treatment of duodenal ulcer. It rarely develops subsequent to surgical procedures for gastric ulcer and seldom occurs among women. It can best be prevented by drawing surgical indications more sharply by performing primary partial gastrectomy in those cases of duodenal ulcer in which experience has shown that gastrojejunal ulcer is likely to develop and by emphasizing the necessity of maintaining a reasonable medical management following the operation of gastroenterostomy.

The diagnosis is usually not difficult, but should depend upon clinical evaluation of the patient's history, roentgenologic examination of the stomach, duodenum, gastroenteric stoma and the jejunum. Such roentgenologic studies may fail to reveal the presence of a gastrojejunal ulcer in 38 per cent of the cases, even when craters are present, although deformity of the gastroenteric stoma can be demonstrated in about 91 per cent of such cases.

Extensive partial gastrectomy of the posterior Polya type has given the best results with the lowest operative mortality when the condition of the patient permits the use of the procedure. If it does not, partial gastrectomy can be done as a secondary procedure, after the patient recovers from the disconnection of the gastroenteric anastomosis and excision of the gastrojejunal ulcer. Although the results of other less radical surgical procedures may be satisfactory in about half of the cases, in the other half, recurrence of the duodenal ulcer will take place, necessitating partial

gastrectomy. This will be more difficult and will be associated with an increased risk owing to the shortening of the duodenum as the result of the recurring duodenal ulcer.

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GASTROJEJUNOCOLIC ULCER AND FISTULA

WALTMAN WALTERS, M.D. AND O. THERON CLAGETT, M.D.

Division of Surgery, The Mayo Clinic — Assistant Surgeon, The Mayo Clinic

ROCHESTER, MINNESOTA

GASTROJEJUNOCOLIC fistulas present a formidable surgical problem. The corrective operative procedures combine the hazards of a gastric operation with the risks of operation on the colon in a case in which the patient usually is debilitated, emaciated, and anemic as a result of the nutritional disturbances resulting from the fistula. Although gastrojejunocolic fistulas occur in association with malignant lesions, they are almost always secondary to gastrojejunal ulceration and secondary to a posterior gastrojejunal anastomosis, with or without gastric resection. Surgical treatment should include not only removal of the gastroenteric stoma, closure of the colonic fistula and reëstablishment of gastrointestinal continuity, but also should control the ulcer-forming diathesis of the patient, at the same time if the condition of the patient permits, or later if it does not. Frequently, it is wisest and safest to perform the operative procedures in more than one stage. The necessity of surgical treatment lies in the inability to control the nutritional disturbances by any measures which do not allow an adequate diet to be assimilated from the small intestines.

ETIOLOGY

Prior to the development of posterior gastroenterostomy in the treatment of benign ulcers of the stomach and duodenum, fistulas between the stomach and colon very rarely were produced by malignant lesions of the stomach ulcerating into the colon or vice versa. Gastrocolic fistula secondary to a malignant lesion was first reported by Haller, in 1755. In 1900, Zweig was able to collect seventy cases from the literature and, in 1925, Verbrugge reported 121 cases in which gastrocolic fistula occurred secondary to carcinoma of the colon and stomach. Brinton, in a study of 505 cases of carcinoma of the stomach, found eleven instances of gastrocolic fistula, an incidence of 2.1 per cent. As mentioned previously, this complication is now rarely seen, owing to earlier diagnosis and treatment. As recently as 1936, however, Louria and Rothstein reported a case in which gastrocolic fistula was secondary to carcinoma of the stomach. Malignant lesions of the stomach or colon may be strongly suspected in cases of gastrocolic fistula if there is no history that gastroenterostomy has been performed.

According to Glickman, abscess in the peritoneal cavity, tuberculosis and congenital anomalies may rarely result in a gastrocolic fistula. Bargen and his associates have reported one case in which gastrocolic fistula was secondary to chronic ulcerative colitis.

At present, most gastrocolic ulcers and fistulas are secondary to gastrojejunal ulcers which occur after gastroenterostomy has been performed for benign ulcers of the duodenum. The infrequent development of these complications following the establishment of a properly functioning gastroenteric anastomosis should be emphasized, however, as gastroenterostomy in properly selected cases is an operation of great value and is associated with a low operative risk. It has been the past experience at The Mayo Clinic that gastrojejunal ulceration occurs in only about 3 to 4 per cent of cases in which the operation is performed.[2] It rarely occurs when it is a part of an operative procedure for gastric ulcer and seldom occurs among women. Walton reported only one instance of gastrojejunal ulcer in 683 cases in which gastroenterostomy was performed for gas-

tric ulcer, as compared with twenty-nine instances in 893 cases in which the operation was performed for duodenal ulcer. In thirteen of Rife's series of fourteen cases of gastrojejunocolic fistula the original lesion was a duodenal ulcer. Rife reported one case in which gastrojejunocolic fistula followed palliative gastroenterostomy for carcinoma of the stomach. In ten of seventy-six cases of gastrojejunal ulcer reported by Loewy, gastroenterostomy had been performed for gastric ulcer. As a rule, however, gastrojejunal ulceration is a result of failure of the gastroenteric anastomosis to control the gastric hyperacidity adequately, a continued lower tissue resistance to gastric secretion and an ulcer-forming tendency on the part of patients who have a duodenal ulcer. Failure to follow a reasonable medical regimen postoperatively may be an important factor in the development of this complication.

INCIDENCE

Although gastroenterostomy was first performed in 1881 and gastrojejunal ulcer was reported by Braun in 1899 and by Quénu in 1902, it was not until 1903 that the first instance of gastrojejunocolic fistula was reported by Czerny. In this case the lesion was removed by a block resection of the stomach, jejunum and colon, and a new gastroenteric anastomosis was established. In 1925, Verbrugge reviewed the literature and found reports of ninety-five cases in which gastrojejunocolic fistula occurred after gastroenterostomy had been performed for peptic ulcer. Verbrugge reported that a jejunal or gastrojejunal ulcer developed in eighty-eight, or 1.41 per cent, of 6,214 cases in which gastroenterostomy was performed for both gastric and duodenal ulcers at The Mayo Clinic prior to January, 1924. A gastrojejunocolic fistula developed in ten, or 11.36 per cent, of the eighty-eight cases. In other words, a gastrojejunocolic fistula developed in only ten, or 0.16 per cent, of the 6,214 cases in which gastroenterostomy was performed. Allen reported that the incidence of gastrojejunocolic fistula was 14 per cent in thirty-six cases of gastrojejunal ulcer. A gastrojejunocolic fistula was present in twenty-three, or 13.6 per cent, of 169 cases of gastrojejunal ulcer in which operation was performed at the clinic in the years 1933 to 1936 inclusive. In the ten-year period, 1928 to 1937 inclusive, operation for gastrojejunocolic fistula was performed in fifty cases at the clinic. In the same period there were seventeen cases in which operation disclosed an impending fistula, that is, a gastrojejunal ulcer which would apparently have perforated the colon if operation had not been performed.

Gastrojejunocolic fistula is almost exclusively found among men. In one of the fourteen cases reported by Rife the patient was a woman. In the ninety-five cases reported by Verbrugge one of the patients was a female and in our series of fifty cases of gastrojejunocolic fistula and seventeen cases of impending fistula only one of the patients was a woman. This incidence is roughly in proportion to the ratio of incidence of gastrojejunal ulcer in the two sexes (we noted only three instances of gastrojejunal ulcer in women in a series of 155 cases) and supports our belief that gastroenterostomy is a safe and usually a satisfactory procedure for the treatment of duodenal ulcer in the female. The incidence of gastrocolic fistula secondary to malignant lesions of the stomach and colon in men and women is in almost direct proportion

Table 1

Age of Patients in Fifty Cases of Gastrojejunocolic Fistula and in Seventeen Cases of Impending Fistula

Age, Years	Gastrojejunocolic Fistula	Impending Gastrojejunocolic Fistula
20 to 30....	5	2
30 to 40....	5	4
40 to 50....	25	10
50 to 60....	13	
60 to 70....	2	1
	50	17

to the incidence of the original lesion in the two sexes. According to Lahey and Swinton, in most cases of gastrojejunocolic fistula the patients are between 30 and 45 years of age. The average age of the patients in Rife's series of cases was 46 years. In most of the cases in our series the patients were between 40 and 60 years of age. (Table 1.)

PATHOLOGY

Gastrojejunocolic fistula seldom occurs after an anterior gastroenterostomy has been performed. It is generally agreed that gastrojejunal fistula cannot occur unless a gastrojejunal ulcer has been present for some time. The fistulous tract is almost always between the jejunum and transverse colon in cases of peptic ulcer. Direct fistulas between the stomach and colon are rare in cases of peptic ulcer. The fistulous tract usually is close to but below the site of the gastroenteric anastomosis and is smooth and clean. There is rarely ulceration of the tract itself. Occasionally, the original gastrojejunal ulcer will be found to be healed. The diameter of the fistulous tract may vary from a few millimeters to 2 cm. or more. There is usually only one fistula. Regurgitation usually occurs from the colon into the jejunum and into the stomach owing to a valve-like action at the site of communication. For this reason, a fistula may not be apparent when the upper part of the gastrointestinal tract is studied roentgenoscopically with a barium meal, but will quickly become evident after administration of a barium enema. The efferent loop of jejunum is usually dilated and hypertrophied. The colon is often constricted at the site of the fistula and dilated proximally. The distal portion of the colon is usually congested, inflamed and even ulcerated by the acid gastric secretions.

SYMPTOMS AND DIAGNOSIS

The diagnosis of gastrojejunocolic fistula is usually not difficult. As mentioned previously, the condition usually affects men who are between 40 and 50 years of age. It usually occurs in cases in which a posterior type of gastrojejunal anastomosis with or without resection has been performed in cases of duodenal ulcer. There is usually a rather long history of recurring symptoms of ulcer. In our series of cases the average duration of ulcer symptoms before gastroenterostomy was nine years. As mentioned previously, a fistula does not occur unless gastrojejunal ulceration has been present for some time. In our series of cases the average length of time that elapsed between the gastroenterostomy and the development of a fistula was forty-five months. In Rife's series of fourteen cases it was four and a half years.

The symptoms are those of recurrence of ulcer distress after gastroenterostomy. There often may be severe pain which is followed after some months by the development of a persistent diarrhea. Usually, the pain ceases with establishment of the fistula. The stools are watery, acholic, and often contain large quantities of undigested food. There is frequently a very bad taste in the mouth; the patient belches foul gas and sometimes vomits material which is definitely fecal. There is often marked loss of appetite but occasionally the patient has a voracious appetite. Marked loss of weight owing to the short circuiting of food from the upper part of the intestinal tract is almost invariable. Dehydration and emaciation, often to an extreme degree, are common. Nutritional and vitamin deficiency states are frequently encountered and in cases in which the condition is advanced there may be a serious degree of anemia.

Physical examination usually reveals evidences of severe nutritional disturbances and occasionally an inflammatory mass can be palpated in the epigastrium. Positive roentgenologic evidence is not necessary for a diagnosis of gastrojejunocolic fistula. Balfour and Eusterman reported the results of roentgenologic examination in twenty cases in which the diagnosis of

gastrojejunocolic fistula was verified at operation. The roentgenologic findings were positive in eleven cases, doubtful in one case and negative in eight cases. During roentgenoscopic examination the fistula can usually be visualized more satisfactorily following the administration of a barium enema than it can following the administration of a barium meal.

TREATMENT

In a discussion of the treatment of gastrojejunocolic fistula, the first consideration should concern the method of preventing this complication. Since nearly all gastrojejunocolic fistulas follow posterior gastroenterostomy which usually is performed for duodenal ulcer, it is apparent that the same factors that contributed to the original lesion also contribute to the development of the gastrojejunal ulcer and the subsequent colonic fistula, and that the gastroenterostomy has failed to control the ulcer-forming factors adequately. The failure of posterior gastroenterostomy to control the ulcer-forming factors in an occasional case should not, however, result in a widespread condemnation of posterior gastroenterostomy in the surgical treatment of duodenal ulcer. This procedure has given satisfactory results in more than 90 per cent of cases for a great many years and is still a safe and valuable method of treatment in properly selected cases.

The occasional failure of gastroenterostomy and the possibility of development of disturbances of motility at the site of the anastomosis may be due to an improper selection of cases in which the procedure is used. In our experience posterior gastroenterostomy is applicable and the treatment of choice in the following cases: (1) cases of large obstructing duodenal ulcer in which the patients are elderly individuals; (2) most cases of obstructing duodenal ulcer in which the patients are women; (3) cases in which there is a low concentration of hydrochloric acid in the gastric contents; (4) some cases of subacute and acute perforating duodenal ulcer; and (5) cases of duodenal ulcer in which the patients are in poor physical condition. On the other hand, primary partial gastric resection seems to be the procedure of choice in cases of duodenal ulcer in which the patients are middle-aged men and the concentration of hydrochloric acid in the gastric contents is high, and in cases in which the lesion is of the hemorrhagic type. Primary partial gastric resection is also often indicated if the patient's occupation or his temperament is such that a regulated dietary regimen and elimination of acid stimulating factors, principally nicotine and alcohol, will not be followed.

In other words, we feel that gastrojejunocolic ulcer and fistula can best be prevented, not by discarding posterior gastroenterostomy, but by limiting its use to the type of case in which experience has shown it can be depended upon to give good results and by using primary partial gastric resection in those cases in which a gastrojejunal ulcer is liable to develop. We feel sure that gastrojejunocolic ulcer and fistula will become less of a problem in the future as the indications for gastroenterostomy and gastric resection are better understood and appreciated. Gastrojejunal ulcer will also become less frequent as patients with duodenal ulcer are brought to realize the necessity of continuing a reasonable medical regimen postoperatively. In those cases in which gastrojejunal ulcer unfortunately develops, colonic ulcer and fistula can best be prevented by earlier diagnosis of the ulcer and prompt surgical treatment. In our series of cases an average interval of four and a half years had elapsed between the performance of gastroenterostomy and development of fistula. This fact emphasizes the necessity of a postoperative follow-up in all cases in which operation is performed for a gastric or duodenal ulcer, in order that a recurrent ulcer can be recognized in its incipiency and treated before serious complications develop.

In cases of duodenal ulcer, gastrojejunocolic fistula may also be prevented by an

anastomosis of the jejunum to the stomach anterior to the colon rather than posterior, as the anterior procedure prevents the gastrojejunal anastomosis from coming into contact with the colon and thus prevents a gastrojejunal ulcer from extending into the colon. Furthermore, if secondary operative procedures for recurring ulceration should become necessary they are usually easier and safer to perform if an anterior anastomosis has been made, because the gastroenteric stoma is more readily exposed and mobilized. However, it has been our experience that stasis occurs in the proximal loop and necessitates an enteroanastomosis because of the longer loop of jejunum necessary in the performance of an anastomosis anterior to the colon. Such an enteroanastomosis decreases the amount of alkaline intestinal secretion that enters the stomach and hence the reduction in the acidity of the gastric contents is not comparable to that which occurs when an enteroanastomosis is not made. This may be a deciding factor in the development of a gastrojejunal ulcer in a case in which the tissue of the jejunum lacks resistance to the acid gastric secretion. The importance of tissue resistance is evidenced by the fact that clinical experience has shown that anterior anastomosis with enteroanastomosis produces very good results in many cases.

The surgical management of a fully developed gastrojejunocolic fistula is hazardous and difficult owing to the poor condition of most of the patients and to the previous surgical procedures. However, surgical intervention offers the only hope. Operation should be attempted as soon as the physical condition of the patient will warrant such a procedure.

Several days of preoperative hospitalization are usually necessary. During this time the dehydration and anemia can be treated by intravenous administration of fluids and by transfusion. The stomach and bowel should be cleansed as thoroughly as possible by gastric lavage and by enemas. During this time a highly nutritious diet should be used and vitamin preparations should be administered.

The operative procedure to be carried out in an individual case can only be determined after examination of the lesion and an estimation of its extent. All procedures must be performed with a most meticulous technique to prevent contamination from the colon.

The various types of operative procedures performed at the clinic in our series of cases of gastrojejunocolic fistula and impending fistula are shown in Table II.

TABLE II
OPERATIVE PROCEDURES EMPLOYED IN FIFTY CASES OF GASTROJEJUNOCOLIC FISTULA

Operative Procedure	Cases
Disconnection of gastroenteric anastomosis; closure of the openings in the stomach, jejunum and colon	18
Disconnection of gastroenteric anastomosis; closure of the openings in the stomach, jejunum and colon; gastric resection	9
Disconnection of gastroenteric anastomosis; closure of the openings in the stomach, jejunum and colon; pyloroplasty	14
Disconnection of gastroenteric anastomosis; closure of the colic fistula at the site of the gastroenteric anastomosis	2
Disconnection of posterior gastroenteric anastomosis; anterior gastroenterostomy and enteroanastomosis	3
Other procedures	4
Total	50

It is apparent that no one procedure is applicable to every case of gastrojejunocolic fistula and that the surgeon must have a wide variety of procedures at his command in order to be able to contend adequately with all the problems encountered. It is well known that in cases of gastrojejunal ulcer and gastrojejunocolic fistula there is a weakened tissue resistance to peptic ulceration; in other words, there is an ulcer-forming diathesis. Experience has shown that prevention of recurrent ulceration in such cases requires radical measures and that extensive partial gastrectomy is the procedure which most adequately controls the ulcer-forming tendencies. It becomes apparent, therefore, that the surgical treatment of gastro-

jejunocolic fistula usually must include extensive partial gastrectomy. Since it is frequently not advisable to perform such an extensive operation on an emaciated, debilitated patient because of the poor operative risk, the operation often should be divided into two stages. The first stage includes restoration of the gastrointestinal continuity in order to permit adequate nutrition, and the second stage, which should be performed after the patient has regained his strength, should attempt to control the ulcer-forming tendencies permanently.

A simple removal of the posterior gastroenteric anastomosis with closure of openings in the stomach, jejunum, and colon is probably the safest procedure that can be carried out in cases of gastrojejunocolic fistula. This procedure is applicable if the pylorus and duodenum are patent, if the fistula is small, and if there is not too much inflammatory reaction about the fistula. It may be necessary to add a pyloroplasty to this procedure in order to relieve duodenal obstruction caused by contraction of the original duodenal ulcer. Great care must be taken with all steps of the procedure. All adhesions should be divided and structures freely mobilized before attempting to disconnect the gastroenteric anastomosis. Contamination from the colonic fistula must be prevented by careful packing off the contents of the rest of the abdominal cavity and by careful surgical technique. Closure of the fistula should be the first consideration as soon as the colon is freed from the jejunum and stomach. The opening in the colon is closed with catgut sutures and the site of the fistula is inverted with interrupted silk sutures. The silk sutures should be placed in healthy tissue away from the infected, inflamed tissue surrounding the fistula. A pad of omentum which has been tacked over the site of the fistula will help prevent any leakage. Openings in the stomach and jejunum are then closed by using three rows of sutures; the two outer rows consist of interrupted silk sutures. The opening in the mesocolon is closed with interrupted catgut sutures. The operative field is then carefully irrigated with physiologic saline solution at body temperature. Reconstruction of the gastric outlet in order to eliminate duodenal obstruction can then be performed if necessary. It should be kept in mind, however, that this procedure may add to the difficulties of closure of the duodenum if partial gastric resection at a later date becomes necessary; therefore, the procedure should not be performed unless the pylorus or duodenum is badly constricted.

In cases of gastrojejunocolic fistula in which the fistula is large and there is considerable inflammatory reaction around the anastomosis, more extensive procedures, such as en bloc resection of the jejunum and colon or stomach, may be necessary. This is such a formidable and hazardous procedure that it should be attempted as a one-stage procedure only as a last resort. In the experience of one of us (Walters) this has never been necessary. Recently, Pfeiffer has noted improvement in the patient's condition and a decrease in the size of the fistula after performance of a colostomy proximal to the gastrojejunocolic fistula. Lahey and Swinton have suggested a two-stage procedure in such cases. The stomach is sectioned above the site of the gastroenteric anastomosis. The proximal end is anastomosed to the jejunum below the site of the gastroenteric anastomosis and the distal end of the stomach is closed. At a later date, after the patient has regained his strength, a resection of the distal portion of stomach and closure of the openings in the colon and jejunum is performed.

Occasionally, disconnection of the gastroenteric anastomosis with closure of the openings in the stomach and jejunum and exteriorization of the portion of the transverse colon in which the fistula is situated is a safer procedure, especially if the fistula is large or if there is stenosis of the colon at the site of the fistula which may cause obstruction. This procedure results in a

double barrel type of colostomy which can be closed at a later date.

In cases of gastrojejunocolic fistula Scrimger has devised a technique in which he performs a gastric resection and leaves a cuff of stomach around the anastomotic ulcer. The gastric mucosa is dissected from the flaps which are sutured firmly together. The proximal end of the stomach is anastomosed to the jejunum distal to the fistula, as in any Polya type of resection. He made no attempt to deal with the fistula between the jejunum and colon as he believed that it would almost invariably close after diversion of the gastric contents. Estes, in 1932, described a procedure which was very similar to that suggested by Scrimger.

Allen has suggested en masse resection of the colon, jejunum and stomach by using the Kerr aseptic technique of anastomosis for restoration of gastrointestinal continuity. This method largely prevents contamination of the abdominal cavity, but frequently it may be technically very difficult, especially in cases in which there is a short jejunal loop proximal to the gastroenteric anastomosis.

Kelly preferred to operate on gastrojejunocolic fistulas in one stage. He advised taking down the gastroenteric anastomosis, closing the fistula or even resecting a portion of the colon, closing the jejunum and then completing the operation with an extensive partial gastric resection of the Polya type. He has carried out this procedure eight times with two deaths.

Finsterer preferred to carry out the operative procedures in one stage but said that a two-stage procedure is advisable if a simple closure of the colonic fistula is impossible. He reported thirteen cases with five deaths.

It is our opinion that although a one-stage extensive partial gastric resection of the stomach is greatly to be desired, it should not be carried out with excessive risk to the patient's life. In most of these cases the first consideration should be concerned with the restoration of a gastrointestinal continuity which will allow a return to normal nutrition and good general health. Control of the ulcer-forming tendencies should be a secondary consideration. We believe that in most cases the surgical treatment of gastrojejunocolic fistula can be carried out as a two-stage procedure with considerably less risk than as a one-stage procedure. However, the patient must be impressed with the fact that the second stage of the operation, which includes gastric resection, is an integral part of the treatment and that it should be carried out as soon as his condition will permit. The resection should be carried out before recurrent duodenal ulcer has had an opportunity to develop, since an acute duodenal ulcer would interfere materially with closure of the duodenal stump. The patient must also follow a rigid medical management during the interval.

The danger of any surgical procedure in cases of gastrojejunocolic fistula is extremely high owing to the patient's poor condition and the extensive procedures necessary. Allen reported a mortality of 25 per cent in eight cases; Lahey and Swinton, an immediate mortality of 63 per cent in eight cases; Rife, a mortality of 20 per cent in fourteen cases, and Wilkie, a mortality of 40 per cent in his series of cases. There was a mortality of 32 per cent in the fifty cases in which operation was performed at the clinic in the years 1928 to 1937 inclusive.

GASTROJEJUNAL ULCER WITH IMPENDING GASTROJEJUNOCOLIC FISTULA

Table III indicates the operative procedures carried out in seventeen cases of impending gastrojejunocolic fistula seen at the clinic in the years 1928 to 1937 inclusive. In these cases a gastrojejunal ulcer had penetrated so deeply into the walls of the colon that perforation would have been inevitable if operation had not been performed. These cases are included because they present a strong argument for early surgical treatment of gastro-

jejunal ulcer. When operation can be performed before a gastrojejunocolic fistula has developed, the surgical risk is much less than it would be if operation were delayed until a fistula had developed. It is thus possible to perform partial gastric resection in a greater number of cases.

TABLE III

OPERATIVE PROCEDURES EMPLOYED IN SEVENTEEN CASES OF IMPENDING GASTROJEJUNOCOLIC FISTULA

Operative Procedure	Cases
Disconnection of gastroenteric anastomosis and resection of the stomach	11
Disconnection of gastroenteric anastomosis; pyloroplasty	3
Disconnection of gastroenteric anastomosis	2
Disconnection of posterior gastroenteric anastomosis; anterior gastroenterostomy and enteroanastomosis	1
Total	17

In cases of impending fistula the patient is usually in better condition than in cases of fistula since nutritional disturbances have not been caused by the fistula. However, the gastrojejunal ulcer is usually so acute and the symptoms are so severe that the patients are not in good condition for extensive operation. In cases of impending fistula it is best to leave the base of the ulcer attached to the colon. The omentum may be sewed over the base of the ulcer for additional protection. Since there is no danger of fecal contamination, extensive surgical procedures can be carried out. Partial gastric resection was performed in eleven of the seventeen cases in our series. The immediate surgical mortality was 12 per cent as compared to a mortality of 32 per cent in cases in which a fistula had developed.

A gastrocolic fistula that is secondary to a malignant lesion of the stomach or colon is rarely amenable to operative treatment. In most cases metastasis has occurred or the lesions are so extensive that they cannot be removed. The most satisfactory procedure when it can be performed is en bloc resection of the stomach and colon with restoration of gastrointestinal continuity, or resection of the stomach and exteriorization of the involved portion of the colon.

SUMMARY

Gastrojejunocolic ulcers and fistula present a most formidable surgical problem. They are a complication of gastrojejunal ulcer which occurred in about 3.2 per cent of cases in which gastroenterostomy was performed at the clinic. Gastrojejunocolic fistula occurs in about 14 per cent of cases of gastrojejunal ulcer and in about 0.5 per cent of cases in which gastroenterostomy is performed. Patients who have gastrojejunal ulcers should be operated upon before the ulcer perforates into the colon and a fistula occurs. Gastrojejunocolic fistula occurs almost exclusively among men; it usually affects men who are between 40 and 60 years of age. The surgical treatment of gastrojejunocolic fistula is difficult and hazardous, but it is imperative as soon as the condition of the patient can be improved sufficiently to warrant such a procedure. Surgical management should include not only closure of the fistula but also measures to control the ulcer-forming tendencies of the patient. Two-stage procedures are frequently advisable.

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In most instances the inflammatory process in a crypt undoubtedly subsides spontaneously with no treatment. It is evident, however, that infection in the depths of the ducts extending from the crypt will not clear up so readily but may persist for a considerable period just as a gonorrheal infection, for example, will be harbored for a long time in the peri-urethral glands.

OPERABILITY, MORBIDITY, AND MORTALITY FACTORS IN CARCINOMA OF THE COLON*

ALTON OCHSNER, M.D. AND MICHAEL DEBAKEY, M.D.

Professor of Surgery, Tulane University School of Medicine

Instructor in Surgery, Tulane University School of Medicine

NEW ORLEANS, LOUISIANA

THE most frequent site of carcinoma in both sexes is the gastrointestinal tract and of all the malignant lesions involving this system, those of the large bowel offer the best prognosis. According to Lord Moynihan[1] "few places in the body affected by carcinoma are so accessible and safe to curative operations." The relatively good prognosis in carcinoma of the colon is dependent upon several factors, significant of which are: (1) greater operability, (2) greater benignancy, and (3) increased life expectancy.

The operability of carcinoma of the colon varies considerably, but as compared with malignant lesions of the rest of the gastrointestinal tract is relatively high. In the reported statistics it varies from 38.5 per cent[2] to 81.3 per cent.[3] In a total series of 4,561 collected cases[2–24] of carcinoma of the large bowel, 2,670 (58.5 per cent) were operable. Rankin and Olson[25] state that the highest operability for carcinoma of the colon at the Mayo Clinic was 68 per cent. Of the twenty-three different reports concerning operability, fifteen (65.2 per cent)[3,5–7,10–12,14–17,20–22] had an operability of 50 per cent or better, and eight (34.7 per cent)[2,4,8,9,13,18,19,23] an operability less than 50 per cent. Koch[18] found that 51 per cent of right-sided lesions were resectable and only 35 per cent of left-sided tumors could be removed. Dixon[26] states that about 50 per cent of cecal carcinomas can be completely removed. Jacobson[10] observed that 75 per cent of right-sided lesions, 80 per cent of the transverse colon lesions, 63 per cent of the splenic flexure and descending colon lesions, and only 30 per cent of sigmoid tumors were operable. The low incidence of operability of sigmoid lesions was due to their late recognition. Geschickter[16] found that of 250 cases of carcinoma of the colon the operability was as follows: ascending colon (seventy-five cases) 53 per cent, hepatic flexure (fifteen cases) 85 per cent, splenic flexure (twelve cases) 45 per cent, and descending colon (eighty-five cases) 47 per cent.

Jacobson[10] reports the following operability according to ages: from 20 to 30 years, 50 per cent; from 30 to 40, 100 per cent; from 41 to 50 years, 57 per cent; from 51 to 60, 61.5 per cent; from 61 to 70, 58.8 per cent, and from 71 to 80, 25 per cent. Jordan[27] found that the incidence of operability at the two extremes of life was not so great as in the intervening periods. Whereas from 21 to 30 years and from 71 to 80 years the operability was only 40 per cent, from 31 to 40 and from 41 to 50 it was 80 per cent and 60 per cent, respectively.

The operability of cancer of the colon is further illustrated by the autopsy statistics of Larson,[28] Harding and Hankins.[29] The first author[28] found that of 210 cases of carcinoma of the colon coming to autopsy, 113 had either no metastases at all or only a few small regional glands which were resectable. Harding and Hankins,[29] in 118 post-mortem examinations, found no apparent metastases in 41 per cent and in an additional 4 per cent the metastases were readily amenable to surgical extirpation. It is thus evident that in 44 per cent of this group of fatal cases lesions were resectable. It is of interest that of thirty-five cases in which palliative operations were performed in this group, twenty were found to be resectable.

* From the Department of Surgery, School of Medicine, Tulane University, New Oreleans, La.

Undoubtedly, in many instances cases are erroneously considered inoperable at the time of exploration because of the size and fixation of the lesion. Whereas the appearance of the tumor and its fixation may suggest only neoplastic growth, not infrequently much of this process is actually inflammatory. We have repeatedly observed that complete deviation of the fecal stream away from the involved segment results in regression in the tumor and return of bowel mobility. This can be accomplished best by the defunctionalizing operation.[30–34] As the result of this procedure there occurs, in addition to the local improvement in the lesion, general improvement of the patient. As we previously stated,[33,34] the operability is greatly increased not only because of decreased size and diminished fixation, but also because more extensive resections are possible.

The mortality rate following extirpation of carcinoma of the colon is, as might be expected, relatively high because extirpation of the colon entails considerable risk. It varies considerably in different hands and is undoubtedly dependent upon the time at which the diagnosis is made, the extent and the malignancy of the lesion, the preoperative preparation, and the type of operation performed. In the hands of most surgeons, radical resection of the colon for carcinoma gives a mortality rate of approximately 20 per cent. In a series of 2,991 collected cases[2–5,7,9,10,12–15,18–20,22,23,24,35–43] in which resection of the colon was done for malignancy, there were 422 (21.7 per cent) deaths. The lowest reported mortality rate is that of Haggard,[37] 3.1 per cent in a series of thirty-two cases and the highest, 63 per cent, reported by Adams[2] in a series of twenty-seven cases. Of the twenty-six reports, the mortality rate was less than 20 per cent in ten (34.6 per cent).[4,7,13,15,18,20,36–38,41] It is of significance that Rankin[38] had 493 cases with only sixty-eight deaths (13.7 per cent). Jones[41] had a remarkably low mortality rate, reporting 161 cases with sixteen deaths (10.5 per cent). According to Fowler,[44] the mortality rate is high under 26 years of age, approximately 50 per cent. Finsterer[20] had seven deaths in thirty-five cases in the seventh decade, four in twenty-five cases in the eighth decade, and one in three cases in the ninth decade. In MacFee's[23] cases, the highest mortality rate (27.9 per cent) followed the exteriorization operation in sixty-eight cases, and the lowest mortality rate (16.1 per cent) followed an aseptic anastomosis in fifty-six cases. In thirty-two cases in which open suture was performed, there were six deaths (18.8 per cent).

Generally, resections of the right colon are considered safer than resections of the left colon. In ninety-one cases of right-sided colectomy reported by Allen,[42] seventeen (18.6 per cent) died, whereas of 169 cases of left-sided resection, thirty-nine (23.8 per cent) died. Paus'[12] mortality in right-sided colectomies was 17.1 per cent, as contrasted with 31.1 per cent in left-sided colectomies. Rankin[38] had 160 cases with right-sided colectomies with fourteen deaths (8.7 per cent) and 333 cases with left-sided colectomies with fifty-four deaths (16.2 per cent). Rosser,[45] on the other hand, had mortality rates of 52 per cent following right-sided and 22 per cent following left-sided colectomies. The respective mortality rates following resection of the midcolon were 33 per cent and 20.4 per cent in Rosser's[45] and Mayo and Simpson's[24] series.

The life expectancy following resection of the colon for carcinoma varies considerably in different statistics. Generally speaking, the outlook following the adequate removal of carcinoma of the colon is relatively good. Of a series of 3,911[3,5,7,9,11,12,14,15,18–21,23,46,47] reported resections for carcinoma of the colon there were 1,204 (30.7 per cent) five-year cures. The highest incidence of five-year cures was obtained by Oughterson and Shelton[11] (52.6 per cent) in a series of 131 cases. Of those patients who survived three years, 72.7 per cent were still alive at the time of their report. Rankin[46] in a series of 753 cases had five-year cures in 45.8 per cent.

Pemberton and Dixon,[47] in a series of 1,920 resections of colon performed at the Mayo Clinic, had five-year cures in 22.2 per cent. Seven of the fifteen reports[9, 11, 12, 18, 20, 21, 46] had five-year cures ranging from 40.8 per cent of 52.6 per cent. Dixon and Olson[48] reported twelve patients who lived twenty years or longer following a resection for carcinoma of the bowel. According to Martin,[49] right-sided lesions give a better prognosis than left, as regards length of life. He states that if the tumor is adequately removed the patient is likely to have freedom from recurrence from four to eight years. Dixon[26] states that 56 per cent of all patients who have had resection of the cecum for carcinoma are well five years or more. If one includes those cases in which there are no nodes, the incidence of a five-year cure is 62 per cent. Geschickter[16] reported 20 per cent cures for carcinoma of the ascending colon, 21 per cent cures for the hepatic flexure, no cures for the splenic flexure, and 20 per cent cures for the descending colon. The percentages of five-year cures according to location in Pemberton and Dixon's[47] series were as follows: cecum 51.8 per cent; transverse colon, 48.9 per cent; descending colon, 40.6 per cent; and sigmoid, 36.9 per cent. Whereas the incidence of five-year cures following resection of the colon for carcinoma is relatively high, the prognosis even in these cases should be guarded as demonstrated by the statistics of Paus[12] and Abell.[9] The former found that whereas 48.4 per cent of patients subject to radical resection were free from recurrence five years postoperatively, only 30.7 per cent were free from recurrence at the end of ten years. Of twenty-five patients surviving radical resection reported by Abell, sixteen (64 per cent) were living at the end of five years but only six (24 per cent) living ten years or longer.

The outlook in intestinal cancer has become more favorable in the past decade, but it still remains far from ideal. This is influenced by a number of factors which can be classified in two large groups: (1) uncontrollable, and (2) controllable. Although the factors in the former group (uncontrollable) are of significance from academic and prognostic viewpoints, they are of little therapeutic value. The controllable factors, on the other hand, are of importance, from both standpoints. Thus, they influence prognosis and determine the type of therapy. These factors may be classified as follows:

I. Uncontrollable
  A. Age
  B. Lesion
    1. Type
      (*a*) Macroscopic characteristics
        (1) Cicatrizing
        (2) Ulcerative
        (3) Fungating
        (4) Polypoid
      (*b*) Microscopic characteristics
        (1) Grading
        (2) Histologic types
          (a) Adenocarcinomatous
          (b) Scirrhous
          (c) Medullary
          (d) Colloidal
    2. Extension
      (*a*) Local
        (1) Mural
        (2) Extramural
      (*b*) Distant
        (1) Lymph nodes
        (2) Liver
    3. Location
      (*a*) Right half of colon
      (*b*) Left half of colon
    4. Multiple
  C. Associated disease

II. Controllable
  A. Duration
  B. Preoperative and postoperative management
    1. Decompression
      (*a*) Nonoperative
      (*b*) Operative (colostomy)
        (1) Simple
        (2) Defunctionating
    2. Hydration

3. Vitamin and protein administration
4. Transfusion
5. Peritoneal vaccination

C. Anesthesia

D. Operative management
1. Single stage procedure
2. Multiple stage procedure
3. Restorative procedures

E. Complications
1. Peritonitis
2. Pulmonary

Carcinoma of the large bowel is a disease largely of advancing age and differs from carcinoma of the rectum in that in the former older individuals are more frequently involved. Approximately three-fourths of the former cases occur in the fifth, sixth, and seventh decades. Whereas it may seem that this advanced age might indicate a poor prognosis, actually statistics demonstrate that the prognosis in the older patients with carcinoma of the colon is not particularly bad. Adams[2] states that the older the patient, the more localized is the lesion. Finsterer[22] believes that no patient with colonic cancer is too old or too weak to be operated upon. In seventy-six of his cases in which a radical operation was done, thirty-four (44.7 per cent) were over 60 years of age; nineteen were between 71 and 80, and two were over 80 years of age. Finsterer[50] found that of eighty-six cases under 60 years, 20.9 per cent died; of fifty-four between 60 and 69, 25.9 per cent died, and of five between 80 and 86, 20 per cent died. It is thus obvious that increasing age is not necessarily a significant factor in prognosis. In fact, in the presence of acute ileus in Finsterer's[50] cases, the older patients had a lower mortality rate than those under 60. According to Larson,[28] a patient 60 years of age who has a malignant lesion of the colon has a much better operability chance than one 50 years of age, other factors being equal. Shedden[51] collected thirty-six cases of carcinoma of the colon and rectum in patients less than 12 years of age, of which twenty were in the rectum. Only one of the entire group was known to have lived as long as two years, at which time he died. The poorer prognosis in young individuals with carcinoma of the colon is undoubtedly due to the fact that the lesion in younger individuals is of a more immature type and therefore more malignant. This is borne out by the findings in Rankin and Broders'[52] cases of carcinoma of the rectum. In a series of patients aged 30 years or less, the tumors belonged to grades 3 and 4 in over half (52 per cent) of the cases, in contradistinction to a series of patients of all ages in which less than one-third (31 per cent) of the lesions were in these grades. Rankin and Graham[53] believe that with advancing age, metastases are less likely to occur because of atrophy of the lymphatic structures. It is evident that whereas advancing age in a patient with cancer of the colon increases the operative risk, the lower grade of malignancy in such an individual, prognostically at least, balances and may even outweigh the disadvantages of the former factor.

Of great importance from a prognostic standpoint is the type of tumor in the bowel, because the degree of malignancy varies according to the gross and microscopic characteristics of the lesion. Carcinomas of the large bowel may be classified as adenocarcinomas, medullary carcinomas, mucoid (colloid) carcinomas, and scirrhous carcinomas. Of these, the medullary and mucoid carcinomas offer a poorer prognosis then do the adeno- and scirrhous carcinomas. In Raiford's[19] series, the incidence of five-year cures varied according to these types as follows: cellular or medullary carcinoma, none; primary mucoid carcinoma, none; adenocarcinoma, grade 4, 20 per cent, grade 3, 22.2 per cent, grade 2, 24 per cent, grade 1, 43 per cent; adenocarcinoma with mucoid degeneration, 34.8 per cent; and scirrhous carcinoma, 50 per cent. Rankin and Olson[25] contrasted the results obtained in forty-four cases of mucoid carcinoma with 409 cases of nonmucoid carcinoma. They found that 10 per cent of the entire group of cases were of the

mucoid type. The average postoperative period of life in months in the patients who developed recurrences was 17.6 per cent for the mucoid carcinomas and 26.8 per cent for the non-mucoid group. The percentages of five-year cures for the former was 48, whereas for the latter it was 52. The relatively greater degree of malignancy of colloid carcinomas is illustrated by Hayes'[54] studies. In a series of 100 cases of carcinoma of the large bowel, eight were of colloid type. Of ninety-five involved lymph nodes in the entire series, thirty-nine (41 per cent) occurred in patients with colloid carcinomas. Thus 41 per cent of the entire lymph gland involvement occurred in only 8 per cent of all the cases; the colloid carcinoma group. Harding and Hankins[29] found in autopsy series that 87.7 per cent of 118 cases of carcinoma of the large bowel were of the broad medullary ulcerating or the fibrocarcinomatous (scirrhous) types. Forty-three per cent had no evidence of metastases even though the patients had died of the disease. Twelve per cent of the entire group were of the gelatinous, bulky type, and 50 per cent of these had perforated with the production of peritonitis.

Karsner and Clark[55] found that of the seventeen cases of carcinoma of the sigmoid, 82 per cent were annular. Of twenty-three involving the upper colon, 61 per cent were annular, and of seven in the cecum, none were annular. These figures of Karsner and Clark are particularly significant when one considers that a cicatrizing lesion in the sigmoid is of much more importance than a similar lesion in the cecum, because the fecal contents of the former are solid and obstruction is much more likely to occur. Raiford[19] found that of forty cases of carcinoma of the cecum, two; of eleven involving the transverse colon, one; of nine involving the splenic flexure, one; and of thirty-three involving the descending colon and the sigmoid, seven were of the scirrhous types. The gross type of lesion is also of significance prognostically, because a fungating tumor, particularly of the colloid variety, is likely to be accompanied by severe secondary anemia, whereas the scirrhous type is less frequently associated with anemia, but is more likely to be complicated by obstruction.

Rankin and Olson[25] found that the size of the original lesion was of little prognostic significance in resectable carcinomas. In the patients who died from recurrence following resection, the original tumor measured on an average less than 0.2 cm. greater than those that survived. Generally, they found that right-sided growths, particularly those in the cecum, were larger. The average sizes of tumors of the cecum, right colon, left colon, and sigmoid in the fatal cases with recurrence were 7.7 cm., 7.1 cm., 6.2 cm., and 5 cm., respectively. Of a similar group of cases which survived and were apparently cured, the average sizes were 7 cm., 7.2 cm., 5.7 cm., and 5.4 cm., respectively. Rankin and Olson state, "It has been noted that those malignant growths which project into the lumen give a better result than those in which the predominant direction of growth is toward the serosa." This statement is verified by Craig,[56] who found that of the malignant lesions of the cecum without local metastases, tumors usually protrude into the lumen and invade the wall relatively little. He found that the most frequent site for cancer of the cecum is the posterior wall which influences the prognosis in that lesions in this location are more likely to metastasize early to the regional lymph nodes which are situated posteriorly.

Of great prognostic value is the type of malignant cell. The more immature the cell, the greater the degree of malignancy and the poorer the prognosis. Broders[57] has emphasized the importance of grading carcinomas in various portions of the body by histologic examination. In such a way it is possible for the pathologist to prognosticate within limits in individual cases. Rankin,[46] in a series of 853 cases of colonic carcinoma, found that the incidences of the various grades were: grade 1, 12.9 per cent; grade 2, 57 per cent; grade 3, 21.3 per cent;

and grade 4, 8.79 per cent. In the same series of cases the incidence of five-year cures in those whose tumors were graded 1 and 2 was 49.6 per cent, whereas only 26.4 per cent of those whose tumors were graded 3 and 4 survived five years. Of the five-year cures, 81.4 per cent had lesions belonging to grades 1 and 2 and only 18.6 per cent had lesions graded 3 and 4. The effect of the degree of malignancy on the life expectancy and cures is illustrated further by Rankin and Olson's[25] statistics. In a series of 453 cases of carcinoma of the colon, there were sixty-five in group 1 with 64.6 per cent five-year cures; 277 in group 2 with 54.5 per cent five-year cures; eighty-one in group 3 with 38.2 per cent five-year cures; and thirty in group 4 with 30 per cent five-year cures. This definitely shows the value of malignancy grading and also shows that most of the tumors of the colon are relatively benign. Of the 453 cases, 342 were in groups 1 and 2 (75.4 per cent). Dixon and Olson[48] found that of 453 cases of carcinoma of the colon, 14 per cent were in grade 1, 61 per cent in grade 2, 18 per cent in grade 3, and 7 per cent in grade 4. Of a group of cases with twenty-year cures following removal of carcinoma of the large bowel, 50 per cent were in grade 1. These same authors found that the five-year survivals in the 453 cases were as follows: grade 1, 66 per cent; grade 2, 54 per cent; grade 3, 38 per cent; and grade 4, 30 per cent. Dixon and Olson also found that in these cases metastases occurred twice as frequently from carcinomas of grade 4 as from those of grade 1. These statistics substantiate the statement made above concerning the relative benignancy of colonic carcinomas because even in the higher grades (3 and 4) the incidence of five-year cures is relatively high.

Extension of a malignant lesion in the large bowel can occur by direct invasion and through the lymphatic and blood streams. Lesions remain localized in the bowel wall for relatively long periods of time, but, as emphasized by Felsen,[58] once the neoplastic process has invaded the submucosa, the lymphatics are likely to become involved. This author describes two ways in which lymphatic extension can occur in the bowel wall: (1) by annular extension involving the large, circular intramuscular plexus; and (2) by wedge-shaped extension to the peritoneum. In twenty-one of 118 cases of carcinoma of the large bowel reported by Harding and Hankins,[29] the growth had extended through the bowel wall with resulting perforation. Raiford[19] found, in 190 cases of carcinoma of the colon, forty-seven (24.8 per cent) had metastases to the lymph nodes, seventeen had metastases to the liver (8.9 per cent), and nineteen (10 per cent) had metastases to other locations. Hayes[54] in a series of carcinomas of the colon which he examined particularly with reference to lymph gland involvement, found that 63 per cent had no lymph gland involvement and that the size of the tumor had no relation to the presence or absence of metastases, because twelve of the sixty-three cases with no lymph gland involvement had extensive tumors in the bowel which encircled the lumen. There were thirty-seven cases (37 per cent) with metastases, nine of which had encircling growths. Hayes[54] found that in those cases in which metastases occurred there was usually extension to the nearest lymph node, but occasionally the nodes nearest the tumor were inflammatory, and the more distant nodes were carcinomatous. It is of interest that in the group of cases studied by Hayes, there were eight with colloid carcinoma in which there were metastatic lesions. Of all the involved nodes in the entire group of 100 cases, 41 per cent were found in the group with colloid carcinoma. Equally as important is the fact that 26.3 per cent of the total number of recurrences which occurred during the year and a half period were in this group of 8 per cent of cases in which there was a colloid carcinoma with metastases. Broders[59] states that a colloid carcinoma which has once metastasized is extremely difficult to control.

Craig and MacCarty[56] studied 100 cases of carcinoma of the cecum with special reference to lymph gland involvement and found that 68 per cent were without metastatic involvement and that 32 per cent had involvement of the regional lymph nodes. Of the 100 cases there were twenty with colloid carcinoma. Twelve of these twenty (60 per cent) had metastases to the regional lymph nodes. Of the eighty cases which were not of the colloid group, only 25 per cent had lymph node metastases. It is evident therefore that regional lymphatic extension is approximately two and a half times more likely to occur in colloid carcinoma of the cecum than in the noncolloid types. Harding and Hankins[29] in twelve cases of colloid carcinoma observed metastases in 50 per cent.

The incidence of glandular metastases according to the grading of the carcinoma is of value and interest. Of 753 cases reported by Rankin,[46] grade 1 tumors had glandular involvement in 27 per cent, grade 2, in 35 per cent; grade 3, in 50 per cent; and grade 4 in 56 per cent. Rankin states that a grade 1 cancer without malignant glands has four and a half times better prognosis than a grade 4 carcinoma with malignant glands. Harding and Hankins[29] observed metastases in 56 per cent of the medullary tumors, 22 per cent of the scirrhous and 50 per cent of the gelatinous tumors. Of their entire group of cases the liver was involved in 39 per cent. Of the cases of scirrhous carcinoma, 34 per cent had metastases to the liver. In a series of 190 cases reported by Raiford,[19] seventeen (8.9 per cent) had hepatic metastases. In Harding and Hankin's[29] cases, the lungs and peritoneum were involved in 24 per cent. Paus[12] found that 20 per cent of 206 cases had encroachment upon the neighboring organs. There were metastases in over half the autopsy cases and 25 per cent of the operative cases. The metastases were most often to the lymph nodes and next to the liver and peritoneum.

As has been emphasized by Rankin[60] and others, the prognosis in malignancies of the colon is greatly dependent upon the location of the tumor. Rankin has shown that the prognosis in right-sided colonic carcinomas is much better than in left-sided carcinomas. He has emphasized that metastases occur later in the former lesion than in the latter due to the scanty lymph drainage on the right side as compared with the left. He and Olson[25] showed that right-sided lesions were larger than left-sided ones, probably due to the fact that the fluid contents of the right colon resulted in obstruction relatively late and the patient's attention was not directed to the malignancy. They compared the size of the lesion in a group of patients who recovered over a five-year period of time with the patients who died. These were as follows: of the fatal cases involving the cecum, the average size was 7.7 cm.; the right colon, 7.1 cm.; the left colon, 6.2 cm.; and the sigmoid, 5 cm. In a similar group of cases in which a five-year cure was obtained, the average size in the cecum was 7 cm.; the right colon, 7.2 cm.; the left colon, 5.7 cm.; and the sigmoid, 5.4 cm. According to these figures, it is evident that the size of the neoplasm is of little significance as regards prognosis because of the inconsistent differences in the size of the tumors between the fatal cases and those which recovered. However, of interest is the inconsistent decrease in size of the tumor from the cecum aborally. In this same series of 187 cases involving the right colon and cecum, there were 106 (57.6 per cent) five-year cures. In a series of 266 cases involving the left half of the colon and the sigmoid there were 127 (47.7 per cent) five-year cures. It can thus be seen that in this group of cases the incidence of five-year cures was approximately 10 per cent better on the right side than on the left. Rankin, in another publication,[46] showed that the incidence of five-year cures was 39 per cent in 187 cases of carcinoma of the right colon, of which 34 per cent had nodal involvement. Sixty-six per cent of those without nodal involvement had five-year cures. In the left colon in a series of

266 cases, 31 per cent had nodal involvement. Of this group, there were 29 per cent five-year cures. The incidence of five-year cures in those involving the left colon without nodal involvement was 56 per cent. This again illustrates that prognosis is much better in right-sided lesions, both in those patients without as well as with nodal involvement, the incidence of five-year cures being about 10 per cent greater in both groups.

Pemberton and Dixon,[47] in a series of 1,920 cases of carcinoma of the colon, found that the incidence of five-year cures was as follows: in the cecum, 51.8 per cent; in the remaining portions of the colon down to the sigmoid, 48.9 per cent; the sigmoid, 40.67 per cent; and the rectosigmoid, 36.9 per cent. It is thus seen that the incidence of five-year cures decreases proportionately with the distance from the cecum to the rectum. Left-sided malignancies are of importance and offer a poorer prognosis, everything else being equal, because of the greater likelihood of obstruction on the left side. This is due to the fact that the left-sided lesions are more likely to be stenosing. Of equal importance is the fact that the contents of the left side of the colon are solid, whereas those on the right are fluid. Burgess[61] described 480 cases of colonic carcinoma, of which 35.6 per cent had acute obstruction. Of those with acute obstruction, 13.2 per cent were on the right side and 86.7 per cent on the left. Koch[18] observed an ileus in 23.6 per cent of right-sided lesions and in 37.1 per cent of left-sided lesions. Alvarez, et al.[62] emphasized the likelihood of a larger lesion on the right side as compared with the left. They found that the average surface area of cecal lesions was 51.6 sq. cm. and that of the sigmoid lesions 31.2. Geschickter[16] showed that cures as well as the operability were greater in right-sided lesions than in left-sided ones. In a series of ninety right-sided lesions, 58.8 per cent were operable, of which 20 per cent were cured. In ninety-seven left-sided lesions, 46.8 per cent were operable, of which 17.5 per cent were cured. Geschickter also states that over 50 per cent of carcinomas of the ascending colon and cecum are operable and that 40 per cent of the patients are well after five years. Less than 50 per cent of those with hepatic and splenic flexure lesions are operable, and 10 per cent are well after five years. About 85 per cent of the transverse colon lesions are operable, and 25 per cent are well after five years. The reason there was not a higher incidence of cures in the transverse colon lesions was because of involvement of the stomach. Approximately 50 per cent of descending colon and sigmoidal carcinomas are resectable, and 40 per cent are well after five years. Jacobson[10] has likewise shown that the operability varies according to the location of the lesion. Seventy-five per cent of right sided lesions, 80 per cent of transverse colon lesions, 63 per cent of splenic flexure and descending colon lesions, and 30 per cent of sigmoidal lesions are operable. Koch[18] found that 51 per cent of right-sided lesions were resectable whereas only 35 per cent of left-sided ones were resectable. Of 100 right-sided colonic lesions MacFee[23] found 50 per cent resectable and of 180 left-sided lesions, 54.4 per cent resectable. Mayo and Hendricks[63] have emphasized that carcinoma of the right bowel involves the liver relatively infrequently, whereas carcinoma of the left bowel involves the liver earlier and more frequently because of trauma of the hard feces.

It has been well known that anemia is likely to be a prominent manifestation in right-sided lesions. Alvarez et al.,[62] Karsner and Clark[55] believe that the reason for the greater incidence of anemia in right-sided lesions than in left is that a much larger ulcer is likely to occur on the former side.

In a collected series of 718 cases of carcinoma of the colon,[3,5,7,20,42] the right colon was involved in 285 and the left in 433. The average mortality rate following resection of the right-sided lesions was 19.6 per cent whereas that following resection of the left colon was 24.4 per cent. Crafoord,[3] in a series of ascending colon

carcinomas, had a mortality of 18 per cent; of the transverse colon, 29 per cent; of the descending colon, 37 per cent; and of the sigmoid and rectosigmoid, 42 per cent. Paus[12] obtained a mortality rate of 17.1 per cent in right-sided lesions and 31.1 per cent in left-sided lesions. Söderlund[14] reported eighty-two cases of resection of the colon, in which there were twenty-eight ileocecal resections with five deaths (18 per cent) and fifty-four resections of the transverse and left colon with fifteen deaths (28 per cent). In contradistinction to the reports[3,5,7,12,14,20,42] in which there were lower mortality rates following the resection of right-sided lesions than following left-sided colectomy, is that of Rosser[45] who reported a mortality rate of 52 per cent in right-sided lesions; 33⅓ per cent in midcolon; 22 per cent in left-sided lesions; and 27 per cent in the rectosigmoid.

In the colon as elsewhere, multiple malignant lesions can occur. They influence prognosis, in that, over-looked lesions following the resection of one may cause the death of the individual because of the continued growth of the undetected neoplasm. Of eighty-seven cases of cancer of the colon treated by Abell,[9] there were two with malignant lesions in both the cecum and transverse colon. Warren and Gates[64] collected twenty cases with multiple malignant lesions in the colon, exclusive of the rectum. They state that the incidence of multiple malignant lesions occurring anywhere in the body is 1.8 per cent. In the gastrointestinal tract multiple malignant lesions occur most frequently in the colon and rectum. Hurt and Broders[65] found that of 2,124 malignant lesions, there were six multiple primary lesions in the large bowel. Brindley,[66] in 119 cases in which the tumor was in the colon, found two with multiple primary lesions (1.6 per cent). Miller[5] had 129 cases of cancer of the colon of which four were multiple lesions. Paus[12] in a series of 206 autopsy cases of carcinoma of the colon had seven (3.4 per cent) with multiple growths and of 571 clinical cases there were two (.35 per cent). The largest series of multiple lesions of the large bowel (sixteen) has been reported by Bargen and Rankin.[67] They suggest that the polypi may be a factor in the production of multiple lesions. Cokkinis[68] observed four cases of multiple growths in fifty-four cases of cancer of the colon. At that time (1934), he was able to find only twenty-nine recorded authentic cases of multiple lesions of the large bowel, in three of which the lesion occurred below a colostomy and was probably independent of the primary growth. Mayo and Zellhoefer[70,71] reported two cases with simultaneous lesions in the colon and sigmoid. Klingenstein[72] reports a case of cancer of the transverse colon which was resected. Five years later, a cancer of the sigmoid colon was resected; three years later the uterus was resected for carcinoma; and six years later cancer of the descending colon was successfully removed. According to Norbury,[73] the prognosis following an operation for a malignant lesion of the colon is dependent upon the presence or absence of other lesions such as polypi because if left behind the danger of recurrence is relatively high.

Carcinoma of the colon is not infrequently associated with chronic inflammatory lesions involving the bowel. Reed and Anderson[74] report four cases in which carcinoma followed a long continued infection with E. histolytica. Bargen[75] reports nineteen cases of carcinoma of the colon associated with chronic ulcerative colitis. All of these lesions were resected and none of the patients were living at the time of his report. Bargen and Dixon[76] report twenty-three cases of carcinoma of the colon associated with chronic ulcerative colitis. In eight cases in which two-stage resections were done by Dixon, there were seven recoveries. As suggested by Reed and Anderson,[74] the persistence of the infection may be a factor in the development of the carcinoma as the result of chronic irritation or the associated pseudopolypi which follow the persistent infection. Miller[77] reports a case in which a tuberculous lesion of the

descending colon had a carcinoma grafted upon it.

Obesity associated with carcinoma of the colon is of prognostic significance. An operative procedure is much more difficult in obese individuals and the incidence of infection is greater and of much more serious nature when it occurs.

While the factors discussed above are of great prognostic importance, from a therapeutic standpoint they are of little significance because they are uncontrollable. On the other hand, there are certain factors which are not only of prognostic importance but also of therapeutic value because, being controllable, they can be made to influence the outcome.

Carcinoma of the colon is relatively slow growing and patients are likely to have symptoms for a long time before resorting to radical therapy. Jordan[27] states that of 270 patients with carcinoma of the colon, sixty-nine had symptoms for six months; fifty-two for a year, and thirty-one two years and longer. In a series of fatal cases studied by Karsner and Clark,[55] the duration of symptoms ranged from ten days to forty-eight months, the average being 10.2 months. The average duration of symptoms in those lesions involving the splenic and hepatic flexures was 12.9 months, although for the rest of the colon the average duration was 9.8 months.

Oughterson and Shelton[11] state that 78 per cent of their patients were admitted to the hospital within one year after the onset of symptoms and that 73.4 per cent visited their doctor within three months of the onset. On the basis of their study they believe that the length of time elapsing between the onset of symptoms and admission to the hospital is becoming less.

The duration of symptoms is approximately ten to ten and one-half months according to Rankin,[46] Rosser,[45] and Finsterer.[22] In Rosser's[45] series of cases the duration varied from two months to two years. Adams[2] states that 70 per cent of cases had an average duration of symptoms of eighteen months. The duration of symptoms was longer in left-sided lesions than in right-sided ones. Fifty-six per cent of Lahey's[78] 155 cases had symptoms for six months or less and 85 per cent had symptoms for less than one year. In 129 cases reported by Miller[6] the average duration of symptoms was sixteen months. In 290 cases reported by Cattell[79] the average duration was twelve months. According to Miles,[80] approximately one year is required for a rectal carcinoma to invade the wall of the bowel for about three-fourths of its circumference and that eighteen months are required for complete encirclement of the bowel.

In carcinoma of the colon as elsewhere, the prognosis, everything else being equal, is better the shorter the duration of the symptoms. Obviously, complete extirpation of the lesion can be more readily accomplished if extension beyond the bowel has not occurred. The diagnosis of malignant lesions of the bowel is relatively easy, provided its possibility is always considered.

The prognosis in carcinoma of the colon is greatly dependent upon the presence or absence of obstruction. Generally a patient with a carcinoma of the colon without obstruction has a much better prognosis, irrespective of the type of therapy, than a similar patient with obstruction. In a series of thirty-four cases of carcinoma of the colon admitted to Finsterer's[20] service with acute obstruction, ten died (29.4 per cent). In a similar series of sixty-one cases without obstruction, only nine (14.7 per cent) died. Obstruction associated with carcinoma of the bowel is dangerous to the individual because of a number of factors. It is our opinion that absorption of toxic products occurs in acute obstruction and that a similar although less severe process is operative in chronic obstruction. In addition to this, however, there are much more definite changes, particularly those in the bowel. Proximal to the obstruction there is marked hypertrophy, inflammation, diminished blood supply, and edema of the bowel wall. Herrmann[81] showed that in

the presence of obstruction the permeability of the bowel wall is greatly increased permitting the extravasation of the infective organisms into the pericolonic tissues, thus predisposing to peritonitis, particularly when the bowel is manipulated. Equally as important also is the fact that the material contained within the bowel proximal to the point of obstruction is much more highly infective than that found in the normal bowel. It has long been known that the contents of an obstructed loop are much more toxic than the contents of a normal loop of bowel. This is undoubtedly due to the fact that in the presence of stasis, organisms have a greater opportunity for growth than in the absence of stasis. Rankin[82] states that between 75 and 80 per cent of patients with colonic carcinoma have obstruction at the time they consult a surgeon. Of Graham's[17] thirty-three cases of sigmoidal carcinoma, seventeen (50 per cent) were admitted with acute obstruction.

Little can be done in lowering the incidence of obstruction in colonic carcinoma, except by education of the laity and the practicing physician, but the surgeon is able to do a great deal in these cases by the institution of appropriate therapy. In the presence of obstruction, which unfortunately occurs far more frequently than it should, it is imperative that decompression of the obstructed bowel be done before any radical operative procedure is contemplated. This statement is confirmed by the results of all who have had any experience with the treatment of colonic carcinoma. Of thirty-one cases of carcinoma of the colon in which a radical resection was done with preliminary colostomy in Cheever's[4] series, only three (9.6 per cent) died. Of forty-seven cases in which resections were done without a preliminary colostomy, twelve (25.5 per cent) died. One year later, Cheever[36] reported another group of cases with similar results, i.e., 8.5 per cent mortality in cases with preliminary colostomy and 24 per cent without preliminary colostomy. Crafoord[3] reported forty-four cases operated upon with obstruction of which nineteen (43 per cent) died. Of seventy-seven resected with a preliminary colostomy only twenty-two (29 per cent) died. Finsterer[22] reports that of forty-three cases of colonic carcinoma resected in the presence of acute ileus, thirteen (30.2 per cent) died and of 136 in which resection was done without acute ileus, twenty-seven (19.8 per cent) died. Of five cases of acute ileus treated by one-stage resection four (80 per cent) died. Of nine cases of acute ileus treated by two-stage resection, only one (11.9 per cent) died. Of twenty-three cases of acute ileus treated by three-stage resection, three (13 per cent) died. According to Gordon-Watson[40] a preliminary colostomy will reduce the mortality rate of approximately one-half. Roscoe Graham[17] had a mortality rate of 68 per cent when resection was done in the presence of obstruction, whereas following a colostomy the mortality rate dropped to 7.6 per cent. Von Haberer[83] reported 172 cases of one-stage resection without preliminary colostomy of which forty-five (25 per cent) died. Of 109 cases with colostomy and resection, twenty-two (20 per cent) died but only nine (8 per cent) died as a result of the operation; yet where the one-stage resection was done, most of the fatalities were from peritonitis. Paus[12] had a 16.3 per cent mortality rate following one-stage resection for carcinoma of the colon in the absence of obstruction and 32.3 per cent mortality rate following one-stage resection in the presence of chronic obstruction. This rose to 58.8 per cent in the presence of acute obstruction. The mortality rate following a one-stage resection was 29.8 per cent, whereas that following multiple stage resection was 15.7 per cent.

As most patients with carcinoma of the colon have some degree of obstruction (according to Rankin[53] approximately 75 per cent), the careful preoperative preparation of the patient is extremely important. In those cases in which there is not complete obstruction it is possible to decom-

press the bowel proximal to the obstruction by preoperative saline catharsis. It is a rule in our clinic to give a dram of magnesium sulfate every hour for six to eight doses. In this way, a small liquid stool is formed, which permits evacuation past the incompletely obstructed neoplastic lesion. This should be done several days before the contemplated operative procedure in order that the patient may be completely hydrated before operation. Obviously, it is necessary that the patient be placed on a non-residue diet after cleaning out the bowel. As left-sided lesions are more likely to become obstructed because of the cicatrizing nature of tumors on the left side and also because of the solid contents of the bowel on this side as contrasted with the right, preoperative preparation is particularly important. Even though preoperative preparation can be satisfactorily performed in left-sided lesions, a primary resection of left colon with immediate anastomosis should never be done. Always a decompressing fistula should be performed as a preliminary procedure. In right-sided lesions in the absence of obstruction, it is possible to perform a resection and primary anastomosis without preliminary deviation of the fecal stream, although, as advocated by Allen[42] and Rankin,[84] it is probably preferable even to use the two-stage procedure in right-sided lesions.

Whereas most surgeons employ a simple decompressing fistula in the form of a cecostomy or colostomy as a preliminary procedure in cases of carcinoma of the bowel particularly on the left side in order to relieve the tension on the suture line during healing, more are beginning to appreciate the value of complete "defunctionalization" of the bowel segment. Cheever[36] found that of fourteen cases in which a temporary colostomy or cecostomy was done, in 50 per cent the colostomy failed to prevent fecal leakage at the anastomosis site, and that in 42.8 per cent it was necessary to close operatively the colostomy stoma. On the other hand, in eight cases in which a permanent type of colostomy was performed, there were no leaks at the anastomosis and three of the colostomies healed by primary intention. Cheever therefore believes that if a decompression colostomy is done it should be of the permanent type. In previous communications,[33,34] we emphasized the importance of complete "defunctionalization" of the bowel and protection of the operative site against contamination. As previously stated,[34] as long as fecal contamination of a bowel segment occurs, there will be little decrease in the pathogenicity of the microorganisms within the intestine. Whereas a double barrel colostomy deviates a great part of the fecal stream, almost invariably some soiling of the distal segment occurs. Only by completely excluding this segment of bowel from fecal contamination can there be any material diminution in its bacterial content. A complete isolation of the openings of the proximal and distal segments will prevent the entrance of feces into this portion.

We have been using in left-sided colonic lesions the "defunctionalizing" colostomy suggested by Devine.[30–32] To this author belongs credit for emphasizing the "defunctionalization" and "debacterialization" produced by complete deviation of the fecal stream from the involved portion of bowel. Under such circumstances the safety of resection of a lesion of the bowel is assured, not only because of the decreased number or the absence of pathogenic bacteria but also because of return of normal blood supply and tone to the intestine, all of which are necessary for optimum healing. We[34] reported twenty-six cases in which the Devine type of colostomy was done. Ten had malignant lesions, with the tumors located in the sigmoid or rectosigmoid in all but one instance, in which case it was situated in the splenic flexure. Six had resection of the bowel segment, three were found to be inoperable at the second operation so that the "defunctionalizing" colostomy was left as a permanent one, and one died fol-

lowing the colostomy. Of the six cases in which extirpation of the malignant lesion was accomplished, there was return of normal bowel function except in two cases in which extirpation of the rectum obviated reëstablishing bowel continuity. None of the patients developed peritonitis.

It is important after cleansing the bowel by means of saline catharsis to reëstablish the water balance before operation. This is also true in those patients on whom a preliminary decompressive operation has been done, particularly if the decompression is on the right side of the colon as in a cecostomy or ileostomy, because following such procedures the water loss is considerable. Until water balance has been reëstablished, the patient should not be operated upon. Because many of these patients have lost weight and are likely to have a low glycogen content of the liver, it is the rule on our service to give a high caloric, non-residue diet with large amounts of sugar. We use preferably pure sugar stick candy and large amounts of sweetened fruit juices. In this way the glycogen content of the liver is restored and considerable food value is given.

In addition to decompression of the bowel and hydration of the patient, other preoperative measures of great importance are the replacement of deficient vitamins and the reëstablishment of normal content of plasma proteins. As the result of the infection associated with the ulcerative process in malignant lesions, we have found that a marked vitamin C deficiency invariably occurs. The administration of cevitamic acid in doses of 200 mg. a day is imperative because vitamin C deficiency, as been shown by Saitta,[85] Zoltan,[86] Lanman and Ingalls,[87] Taffel and Harvey,[88] and Allen,[42] interferes with wound healing. It is our observation, too, that vitamin C deficiency greatly predisposes to infection, thus setting up a vicious circle, the deficiency *resulting* from the infection, and the deficiency in turn *predisposing to* the infection. In cases in which there has been a long continued obstruction, the administration of vitamin B preoperatively is of importance. It has been shown clinically and experimentally that vitamin B exerts a definite tonic effect on the large bowel. Sparks and Collins[89] showed that the volume of the colon of rats, maintained on a vitamin B deficient diet, was greatly increased. Vitamin B deficiency has been found by Saitta[90] to interfere with wound healing.

Many patients with carcinoma of the colon, particularly those with lesions on the right side, have a profound anemia, as originally emphasized by W. J. Mayo,[91] in 1913. Alvarez et al.[62] showed that carcinoma of the cecum and ascending colon has a marked tendency to produce severe anemia and they believe that the anemia is dependent upon the surface area of the tumor. They also believe that the size of the colon has a great deal to do with the anemia in that the diameter of the cecum is approximately 6 cm. as contrasted with that of the sigmoid which is 2.5 cm. A much smaller lesion in the sigmoid will produce an obstruction and will cause the patient to seek relief earlier and before the anemia becomes severe than a similar lesion in the cecum. These investigators[62] are of the opinion that the anemia is due to the oozing of the blood from the large ulcerating area which is also a site through which bacteria can enter. Abel[9] found that the average red blood cell count in lesions of the cecum and ascending colon was slightly under four million as contrasted with over four million in the other types. The lowest hemoglobin determination in right-sided lesions was 32 per cent, the highest 90 per cent, and the average 72 per cent. The average hemoglobin determinations for lesions of the transverse colon and splenic flexure were 76.3 per cent and 77.2 per cent respectively. Coons[92] found that the average hemoglobin reading in cases of carcinoma of the cecum and colon was 61 per cent. However, many of these had readings lower than 30 per cent. He also found that the degree of anemia was directly proportionate to the size of the

tumor. Karsner and Clark[55] found that the maximum, minimum, and average hemoglobin percentages for the right half of the colon were 101 per cent, 24 per cent, and 72 per cent, respectively, whereas the respective figures for the left half were 85 per cent, 60 per cent, and 74 per cent. Corresponding erythrocyte counts were 4,850,000; 2,560,000 and 4,035,000 for the right half and 5,464,000; 3,010,000 and 4,408,000 for the left half. Rosser[45] found that anemia occurred almost as constantly in tumors of the transverse colon and the flexures as in tumors of the right colon. He found that a severe anemia occurred in 38 per cent of tumors of the right colon, 30 per cent of the midcolon, and only 6 per cent of the left side. Obviously, the preoperative preparation of patients by repeated transfusion in order to combat the anemia and to replace the plasma proteins is of importance. This is particularly so in view of the recent investigations of Thompson, Ravdin, and Frank,[93,94] who showed that in the presence of a hypoproteinemia there is definite interference with the wound healing. At the anastomotic site following operative excision and reuniting the bowel, edema and retardation of healing are likely to occur as the result of hypoproteinemia. This can be obviated by the replacement of the normal protein which is easily accomplished by the administration of plasma or whole blood.

There has been considerable controversy, particularly recently, concerning the value of peritoneal vaccination. The use of preoperative vaccination of the peritoneal cavity by the introduction of killed streptococci and colon bacilli was popularized by Rankin,[82,84] Bargen,[95,96] and Dixon.[76] Dixon[97,98,99] still advocates this method of preoperative therapy and believes that the preoperative vaccination greatly reduces the mortality rate. In a recent discussion, he[100] stated that in a series of 180 resections of the colon in which intraperitoneal vaccination had been previously performed, there was a total mortality of 6 per cent as contrasted with a similar series in which no vaccination was done with a mortality of 17 per cent. In another publication, Dixon[98] declared that the vaccination decreased incidence of peritonitis at the Mayo Clinic following resection of the colon from 10 per cent to 1 per cent. He stressed the importance of increasing the peritoneal exudate, and stated that a normal peritoneal fluid, which consists largely of monocytes and has a count of about 2,000 per cu. mm., seventy-two hours after the vaccination becomes increased to 95,000 with a very marked increase of polymorphonuclear leucocytes. He[99] also states that more than 2,500 intraperitoneal injects of the vaccine have been given at the Mayo Clinic.

Rankin, who was an ardent advocate of the use of vaccine, as evidenced by reports in 1932[82] and 1934,[84] more recently[101] has discontinued the use of vaccine and believes that the decrease in the mortality rate as previously reported was not due to the use of vaccine but was due to the rehabilitation of the patient and appropriate decompression of the bowel prior to operation. He reports 130 cases with only eleven deaths (8.4 per cent) without the use of vaccine.

Steinberg[102,103] has shown that it is possible to increase the cellular content of the peritoneal fluid by the introduction of his vaccine at the time of operation. This results in an intense reaction of the peritoneum occurring much more rapidly than the growth of organisms. These observations have been corroborated both experimentally and clinically by Coller and his associates.[104,105] These authors are of the opinion that equally good results can be obtained from the use of Steinberg vaccine without the necessity of increasing the peritoneal reaction prior to operation and that the use of the vaccine can be reserved only for those cases in which actual spillage has occurred. Our experience is similar to that of Coller and we feel that the preoperative vaccination is not only unnecessary but undesirable because should accidental spillage occur at the time of operation gross infection of the peritoneum

can be largely obviated by the use of the Steinberg coli bactragen. Obviously, no vaccine will ever take the place of clean surgery, a point which cannot be overemphasized.

There is considerable controversy concerning the best anesthetic to be used in operating upon patients with malignant lesions of the bowel. There is, however, an increasing tendency towards the use of spinal analgesia particularly since the introduction of those anesthetic agents which have a prolonged action. One of the disadvantages of novocaine is that the analgesia is too short to complete an extensive operation. Finsterer,[20] Haggard,[37] Marvin and Donaghy,[106] Behrend,[107] and Cattell[75] all prefer spinal analgesia.

There are definite advantages of spinal analgesia is resecting malignant lesions of the bowel although it must be admitted that in general, spinal analgesia probably is not quite so safe from the anesthetic standpoint as inhalation anasthesia. It is a rule on our service, to use spinal analgesia given by a trained anesthetist in all extensive intra-abdominal procedures. We feel that the advantages to be derived from the use of the spinal analgesia outweigh the disadvantages and the slightly increased danger from the introduction of the analgesic agent into the spinal canal. Complete relaxation, absence of straining, absence of vomiting, and the ease with which the operative procedure can be performed, justify the use of this method. Ravdin and his associates[108] on the basis of their investigations are of the opinion that of all the anesthetics, spinal analgesia produces the least liver damage. It should be emphasized, however, that spinal analgesia should not be chosen as a method of analgesia in order to dispense with an anesthetist. We feel that if ever the services of a trained anesthetist are necessary it is in the use of spinal analgesia employing the newer anesthetic agents, such as nupercaine and protocaine.

Rankin[101] has abandoned spinal analgesia because of the inability to control it. Allen[42] prefers a properly administered gas anesthesia but states that the anesthetic of choice depends more upon the individual administering it than the agent itself.

Whereas everyone is in agreement that in the presence of obstruction the one-stage procedure is probably never justified, particularly on the left side, there is still considerable dispute concerning the type of operation to be used in the absence of obstruction. With few exceptions, the two-stage procedure is used for left-sided lesions in the presence or absence of obstruction because of the danger of insufficiency of the suture line unless a decompressive operation is preliminarily or simultaneously performed. Until relatively recently it was the consensus that right-sided lesions could be resected with impunity in one stage. However, due to the investigations of Allen[42] and Rankin[109] the desirability of using two-stage procedures in right-sided lesions is becoming more evident. Of twenty-one one-stage procedures done for right sided lesions by Abell,[9] seven died (32.9 per cent) whereas only one of six two-stage procedures (16.6 per cent) succumbed. Von Haberer[83] states that of 172 patients with one-stage resection without colostomy, forty-five (25 per cent) died, whereas of 109 with resection and colostomy twenty-two (20 per cent) died, but only nine (8 per cent) died as the result of the operation. Cheever[36] had thirty-five cases with preliminary colostomy of which three (8.5 per cent) died and fifty cases without a preliminary colostomy of which twelve (24 per cent) died. Oughterson and Shelton[11] had seventeen cases in which a one-stage operation was done with two deaths (11.7 per cent); fourteen cases in which a two-stage operation was done with two deaths (14.3 per cent); three cases in which exteriorization was done with one death (33⅓ per cent). Paus[12] had a mortality of 29.8 per cent in one-stage operations, 15.7 per cent when more than one-stage was used. Allen[42] had seventy-three cases of right sided lesions with one-stage resection with fifteen deaths (20.5 per cent); and

eighteen with two-stage resection with two deaths (11 per cent). Of nineteen one-stage resections of the transverse colon three died (15.7 per cent); and of twelve two-stage resections, two died (16.6 per cent). Of ninety-six one-stage resections of the left colon, nineteen died (20 per cent) and of seventy-three two-stage resections, ten died (13.7 per cent). This represented 6 per cent of the 400 one-stage and 3½ per cent of the two-stage operations. Allen is of the opinion that the two-stage operation even for right-sided lesions, is the method of choice. Grey Turner[7] reported a mortality rate of 25.7 per cent in seventy one-stage resections of the large bowel as contrasted with a mortality of 12.5 per cent in seventy-two multiple stage resections.

An exteriorization procedure (Bloch,[110] Paul,[111] Mikulicz[112]) may be used in some cases. Because of the high incidence of metastases to the abdominal wall, which according to him is 7 per cent following the original exteriorization procedures, Rankin[113] has advocated obstructive resection particularly in sigmoid lesions. This consists of division of the mesentery similarly as for resection but instead of performing a resection with anastomosis, clamps are placed on the proximal and distal loops and the bowel removed distal to the clamps. The proximal clamp is kept in place for a period of twenty-four to seventy-two hours and then removed. The distal clamp is kept on until it sloughs off. MacFee[23] reports a mortality rate of 27.9 per cent in sixty-eight cases in which the exteriorization procedure was used, 16.1 per cent in fifty-six cases in which aseptic primary anastomosis was done, and 18.8 per cent in thirty-two cases in which open anastomosis was done. The use of the aseptic anastomosis and its value in decreasing the mortality rate has been emphasized by Rankin[109] and Allen.[42] Kauffmann[114] warns against the use of exteriorization operation in acute obstruction. Of ten cases so treated, seven died. Rankin,[109] for right-sided lesions, advocates ileotransverse colostomy performed aseptically and followed either at the time or subsequently by resection of the bowel. In left-sided lesions, he prefers preliminary drainage of the right side followed by resection or by obstructive resection. In sixty cases of right-sided lesions in which an aseptic ileotransverse colostomy was done, there were only four deaths (6.6 per cent). In cases of left-sided lesions in which obstructive resection was done, the mortality rate was 9.6 per cent. Lahey[78,115] advocates an exteriorization operation with obstructive resection in right-sided lesions. Wilkie[15] had thirty-eight cases in which primary resection was done with five deaths (13 per cent), thirty cases with resection and preliminary colostomy, with three deaths (10 per cent) and twenty-six cases with exteriorization, with five deaths (19 per cent). He emphasized that those cases in which the exteriorization procedure was done were borderline cases as regards operability. Gordon-Watson[40] states that multiple stage operations reduce the mortality rate about one half. Cattell[79] stated that during the period in which primary resection was done without preliminary colostomy, one out of every seven died of peritonitis. Since the introduction of the multiple stage operations, the mortality rate has been cut in half. Two-stage procedures are preferred by Lahey,[116] Dixon,[117] Ransom,[118] and McKittrick.[119]

In carcinoma of the colon, peritonitis is the most frequent cause of death both in operative and non-operative cases. In the latter instance, the ileus with permeation of the bowel by bacteria or the penetration of the bowel by the tumor are responsible for the peritonitis. In the former instance, contamination at the time of the operative procedure or as the result of permeation of the bowel by micro-organisms is responsible for the peritoneal infection. In a collected series of 412 fatalities[2–4,6,7,19,24,39,42,120] following resections for carcinoma of the bowel, 172 (41.7 per cent) were due to peritonitis. Mayo and Simpson[24] reported that of nineteen deaths following extraperitoneal resection of the transverse colon,

twelve were due to peritonitis, and of four deaths following a resection with primary anastomosis, three were due to peritonitis and one other due to separation of the sutures. Of seven deaths following a resection of the right and transverse colon for carcinoma, two were due to peritonitis and two additional ones to separation of the sutures. Of nine deaths following palliative procedures for carcinoma of the transverse colon, six were due to peritonitis. Thus of thirty-three deaths following operation in 204 cases of carcinoma of the transverse colon, eighteen were due to peritonitis and three more due to separation of the suture line, making a total of twenty-one of the thirty-three due to peritonitis. In Allen's[42] series, peritonitis accounted for thirty-three of 110 deaths (30 per cent) following resection of the large bowel. There were twenty-four deaths from peritonitis in 400 one-stage operations, and nine deaths from peritonitis in 253 two-stage operations. Rankin[6] found that peritonitis was the cause of death in fourteen of twenty-six fatalities in 385 palliative colostomies and also in ten of sixteen deaths in 584 cases in which a preliminary colostomy was performed and in which the growth was deemed resectable.

It is thus seen that peritonitis is the most important complication in cases of carcinoma of the colon. As mentioned above, a great deal can be accomplished by appropriate management, i.e., careful preparation of the patient; relief of obstruction; use of aseptic anastomosis; and in those cases in which accidental spillage does occur, the use of the Steinberg coli-bactragen.

Pulmonary complications are second to peritonitis as a cause of death in carcinoma of the colon. Shambaugh[120] found that of fifty-two cases coming to autopsy following surgery of the large bowel, of which forty-eight were for carcinoma, nineteen had pneumonia and an additional one pulmonary embolism. Of 110 deaths reported by Allen,[42] twenty-eight were caused by pulmonary complications; twenty-two of these followed 400 one-stage operations and six followed 253 two-stage operations. As Allen has emphasized, it is of significance that the incidence of pulmonary complications was distinctly lower following the two-stage operations than following the one-stage operation, in spite of the fact that two operations gave a double opportunity for the development of pulmonary complications. This, he believes, is due to the fact that the patients were in better condition and were better able to withstand the pulmonary infection. Rankin[6] observed seven cases of pulmonary complications in twenty-six deaths occurring in 385 cases in which a palliative operation was done for carcinoma of the colon. Five of these were bronchopneumonia, one pulmonary embolism, and one pulmonary edema. Of sixteen deaths occurring in 584 cases in which colostomy was done preliminary to a resection, six had pulmonary deaths, two pulmonary embolism, one pneumonia, and one empyema. Larson[28] had seven pulmonary deaths in 210 cases of carcinoma of the colon coming to autopsy, an incidence of 3.3 per cent.

Peritonitis is the most frequent complication as well as the most frequent cause of death. Second in frequency are pulmonary complications.

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Sterility of the operative field is impossible to obtain in surgery of the rectum and anus except in a few operations which are performed through a perianal skin incision without entering the bowel lumen.

DIAGNOSTIC VALUE OF SIGMOIDOSCOPY AND BIOPSY

FRANK C. YEOMANS, M.D., F.A.C.S.

Professor of Proctology, New York Polyclinic Medical School and Hospital

NEW YORK CITY

THE preëminent value of sigmoidoscopy is for: (1) the discovery of small tumors at their onset; (2) differentiation of other diseases having similar symptoms; (3) exclusion of the terminal bowel (distal pelvic colon, rectosigmoid and rectum) as the site of a neoplasm; and (4) to obtain material for smears and culture, and tissue for histologic study.

Indications. Symptoms referable to the colon and the rectum indicate instrumental examination. These include a change in bowel habit, especially progressive constipation; abdominal unrest and distention; intestinal cramps; bearing down or fullness in the pelvis; morning urgency with the mere passage of flatus and some blood-tinged mucus; frequent sanious discharges of blood, pus and mucus, anemia and weight loss.

By digital palpation, which should always precede sigmoidoscopy, the experienced clinician can usually diagnose correctly a carcinoma situated within 5 inches of the anal verge.

It is an all too common practice when the symptoms suggest a lesion of the large bowel, to refer the patent at once for an *x*-ray study. The procedure should be reversed and the data obtained by proctosigmoidoscopy should be given to the roentgenologist *before* his examination. Ulcers and small tumors within the bony pelvic girdle cannot, as a rule, be visualized by the *x*-ray, whereas direct inspection through the tube reveals at once their presence and character. Sigmoidoscopy is our chief reliance for the discovery of an incipient tumor. A negative Roentgen report frequently engenders a sense of false security until the neoplasm has progressed to a hopeless stage.

The vast majority of inflammatory and neoplastic lesions of the large bowel involve its terminal 12 inches. Consequently they are within range of digital palpation or endoscopy. This is notably true of neoplasms.

During the years 1931–1938 inclusive, 5,723 patients were discharged from the New York City Cancer Institute with the proved diagnosis of malignant disease. Segmental incidence of carcinoma in the digestive tract was: esophagus 163; stomach 560; small intestine 2; cecum 21; colon 49; sigmoid and rectosigmoid 85; rectum 422; this constituted a total of 1302 or 22.7 per cent of all cases discharged. Of the 577 large bowel involvements, 422 (73 per cent) were in the rectum.

Sigmoidoscopy is a relatively simple office procedure. No anesthesia is used, but adults with tender anal lesions may require local anesthesia, and unmanageable infants and children general anesthesia.

An empty bowel is essential, best obtained by 1 ounce of castor oil taken the night before the examination, or by enemas of warm water three or four hours in advance. These measures are omitted if the patient has diarrhea.

With the passage of time ever increasing numbers of physicians appreciate the great value of sigmoidoscopy in diagnosis. Any one interested can become proficient in introducing the tubes, but considerable experience is required to interpret correctly the findings.

Technique. The patient is placed in the knee-shoulder position or is inverted on a Hanes' or similar table.

The technique of sigmoidoscopy is given in detail in books on proctology. Suffice it to say that after the tube has entered the

rectal ampulla, the obutrator is removed to gain the benefit of atmospheric pressure to distend the bowel. Its further passage must be guided by direct vision lest serious injury or perforation of the bowel occur. Perforation is a most serious, frequently fatal, accident that should never occur with proper technique. Pathologic lesions, such as ulcer or cancer, render the bowel wall friable, and the thinned wall of the sigmoid in emaciated persons is easily perforated.

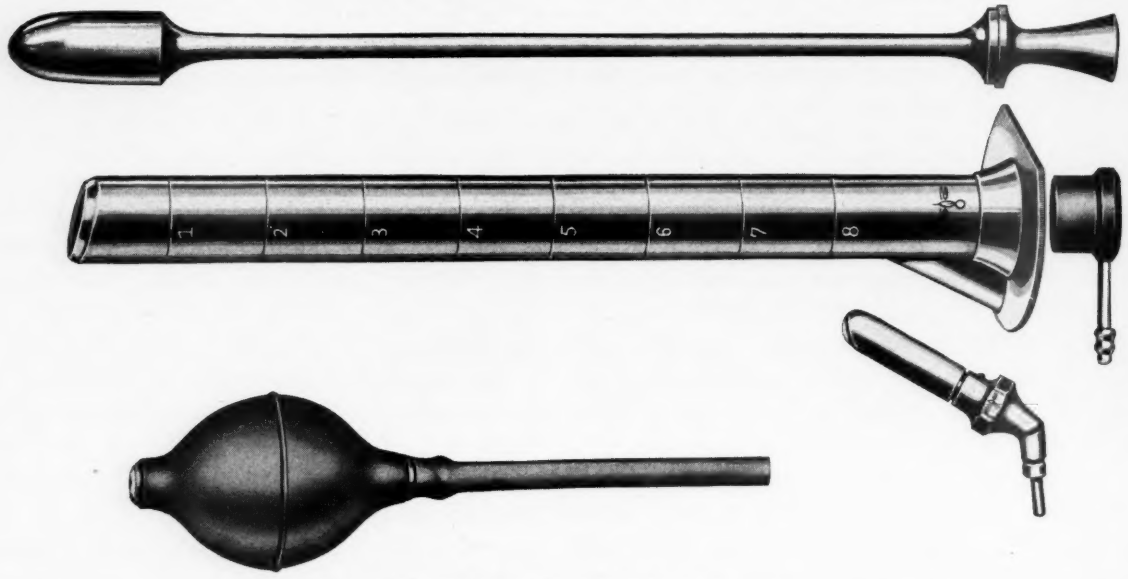

Fig. 1. Yeomans' pneumo-electric proctoscope.

Factors arresting the tube at the rectosigmoid are spasm of the bowel musculature, a short mesosigmoid, adhesions fixing the sigmoid in an abnormal position, organic stricture and neoplasms. However, inspection of an obstructive organic lesion is usually sufficient to establish the diagnosis. Extra-intestinal conditions arresting the tube are the uterus fixed in retroversion, diseased adnexa and adhesions, and fibrous bands following operations on the pelvic organs.

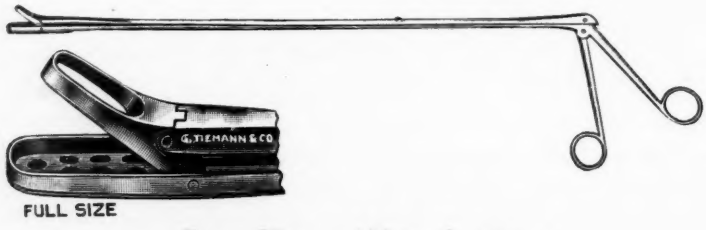

Fig. 2. Yeomans' biopsy forceps.

For a satisfactory examination the tube should be passed at least 10 inches (25 cm.). Fortunately this can be accomplished in about 85 per cent of individuals having a normal bowel or only superficial pathologic changes of the mucosa. The limit of advancement is the apex of the sigmoid which varies from 10 to 14 inches from the anus. Close inspection while the tube is being withdrawn frequently yields the most valuable information.

When a carcinoma involves the entire circumference of the bowel wall, the calibrated tube of ½ inch diameter can usually be passed through its lumen to the normal mucosa above the growth, thus determining at once the length of the lesion.

Data obtainable by proctosigmoidoscopy are: (1) the appearance of the mucosa—normal, atrophic or hypertrophic; (2) recognition of various types of

ulceration, such as tuberculous, amebic, hemorrhagic and chronic nonspecific; (3) the identification of inflammatory stricture; (4) determination of the number, site and distribution of small non-malignant growths, or of carcinoma in all its stages of development; (5) taking material directly for smears and cultures.

Biopsy. To one experienced in the interpretation of a digital palpation, a carcinoma within the palpable area imparts a feel that is diagnostic. However, in all cases of doubtful diagnosis, such as indurated ulcer, amebic or tuberculous granuloma, stricture or tumor, a biopsy is taken with the harmless high-voltage electric snare or punch forceps passed through the proctoscope. This is especially necessary when these lesions are situated beyond reach of the finger and the valuable data of palpation are not obtainable.

The alleged danger of disseminating cancer cells by a properly performed biopsy is minimal in comparison to the positive information obtained. If the tumor is very small, the entire lesion is removed for study. Under direct vision a specimen is taken at a point in the pathologic process most likely to yield the maximum information by histologic study. If the lesion is ulcerated, the specimen is taken from its margin, avoiding necrotic tissue. In non-ulcerated neoplasms the specimen is taken from the tumor itself.

No bleeding follows electric snare biopsy. Immediately after biopsy with the punch forceps, 95 per cent phenol is applied to the wound, and is followed by alcohol; the excess is sponged away. This topical application quickly controls any slight bleeding and effectively seals the lymphatics.

When indicated, biopsy is a part of the routine examination and the patient is not aware that a specimen has been taken. Exceptions to this are: a melanoma, which should never be cut into; a submucous tumefaction, the result of a chronic perirectal inflammation; and a malignant infiltration of colloid carcinoma or sarcoma where the mucosa is intact. If biopsy is decided upon in the latter cases, it should be done carefully by incision with the endotherm knife which seals the lymphatics and small blood vessels, and generally under spinal or general anesthesia.

Biopsy is, as a rule, contraindicated in certain pathologic conditions in which the intact mucosa is usually movable over the surface of the tumefaction but is not grossly implicated in the pathologic process. Examples of this are enlarged lymph nodes of the mesorectum, notably in children with tuberculous adenitis; metastatic involvement of these nodes by carcinoma in adults, and infiltration of the rectovesical pouch or cul-de-sac of Douglas by metastases from malignant tumors or plastic tuberculous peritonitis. In these cases local and general findings, together with other clinical data, usually suffice for a correct diagnosis.

Histologic study of a representative biopsy (1) clinches the diagnosis in doubtful cases; (2) may determine the grade of malignancy of a tumor; and (3) may influence the type of therapy. The highly malignant cancers, graded 3 and 4, are, theoretically at least, more sensitive to irradiation than are those graded 1 and 2.

There are two conditions in which sigmoidoscopy suggests the diagnosis but is not conclusive. In neither of them can the tube be passed beyond the rectosigmoid and bleeding is the leading symptom. One of these is an adenoma in the upper rectum. Its removal may be followed by temporary relief of the bleeding, but within a short time a carcinoma of the pelvic colon is manifest. The adenoma was the "outpost" or danger signal of the more important condition.

The other condition is a carcinoma associated with diverticulitis of the sigmoid. This association is relatively common after the fortieth year and has been found at operation in from 4 to 30 per cent of cases. These citations emphasize the necessity of a Roentgen ray study of the colon with an opaque enema in all cases in which the tube is arrested at the rectosigmoid juncture.

INJURIES OF THE COLON

REVIEW OF SIXTY-TWO CASES IN NEGRO PATIENTS

FRANK K. BOLAND, M.D.

Professor of Clinical Surgery, Emory University Medical School

ATLANTA, GEORGIA

INCIDENCE OF SURGICAL DISEASES OF THE COLON IN NEGROES

IT has been shown many times that surgical diseases of the alimentary tract are far less common in negroes than in white people. Racial characteristics may play a part in this difference, but diet is an important factor. Individuals like the East Indians who subsist on so-called "natural" foods escape almost entirely such lesions as peptic ulcer, gall-bladder disease, appendicitis and carcinoma of the digestive system. Such foods are those which are grown in the community where they are consumed with little delay, and are subjected to but little packing, shipping and storing. On the other hand these diseases occur with marked and increasing frequency in a population whose foods are polished, pickled, frozen, thawed, sterilized and canned, and then transported to distant places where they may remain a long time before being used.

The negro of our Southern states lives on food somewhat similar to that of the East Indians, and a survey of ten years ago made in Atlanta demonstrated that these diseases were four times as common in the white as in the colored race. More recently, as the city-dwelling negro takes on the habits and nourishment of his white neighbor, he has become more subject to the afflictions of the Caucasian. Now these surgical diseases of the alimentary tract are believed to be only twice as common in white patients as in colored.

Such is the record of carcinoma of the colon. During the eight-year period, 1931–1938, among approximately the same number of admissions to the Grady (municipal) Hospital, of Atlanta, there were thirty cases of the disease in white patients, and fifteen in negroes. Traumatic cases, however, show a much higher incidence in the colored race.

INJURIES OF THE COLON

The majority of injuries of the colon are penetrating wounds made by bullets or sharp instruments. Injuries without penetration of the abdominal wall are rare, and there was none in the present series. In 279 cases of gunshot and stab wounds of the abdomen in the Grady Hospital during the past six years (1933–1938) sixty-one (22 per cent) involved the colon, forty-two being due to bullets and nineteen being classed as stab wounds. The latter were made by various kinds of long-bladed knives, intended for the purpose, and turned out to be incisional rather than stab wounds. Contrary to tradition, the razor was used in only one instance, but the result was a penetrating wound extending half way around the body. In one case air was injected into the colon through the rectum, the details being as follows:

> The patient was a male aged 20. With a unique idea of being playful, a companion passed an alemite gun under the patient's coat between his buttocks, and let go a volume of air under 180 pounds pressure. The nozzle of the gun was not inserted through the anus, and it is said that this is not necessary in order for air or gas under pressure to enter the rectum. The patient was blown a distance of 8 or 10 feet, and he declared that he felt full of air from "his heart to his rectum." As he attempted to rise he passed a large amount of air from the rectum and then became unconscious. Brought immediately to the hospital he was cold and clammy, and when he regained consciousness he cried out with great abdom-

inal pain. Maximum tenderness was present in the lower abdomen, especially over the cecum. There was rigidity at first which soon disappeared. There was no distention.

Rectal examination revealed slight tenderness, no masses or discharge, no blood on the examining finger. Palpation over the ascending colon gave a sensation of crepitus. Leucocytes, four hours after the accident, were 17,000. The red blood count was remarkable, and inexplicable. In a patient previously in good health, the red cells four hours after injury numbered 6,995,000, when counted by several competent observers. Hemoglobin was 75 per cent. Wasserman was negative. The high red blood count remained about the same for four or five days, then reached normal. Fluoroscopic examination showed no free air in the peritoneal cavity.

Laparotomy under spinal anesthesia was done through a left paramedial incision. There was no escape of gas when the peritoneum was opened. A small amount of bloody fluid was present. No perforation of the colon was discovered, but the lateral tenia coli of the cecum was split longitudinally through the peritoneal coat for 4 inches, while the same amount of injury existed in the tenia coli on the anterior surface of the sigmoid. Three shorter tears of this kind were found, all longitudinal. The wounds were sutured with fine chromic catgut and the abdomen closed without drainage. The patient was dismissed after two weeks in good condition.

The majority of the patients reached the hospital within from one-half hour to four hours after injury. Negroes with mysterious internal disorders are loath to go to a hospital, but when they are shot or stabbed they know they need prompt attention, and enter the hospital immediately.

All bullets entered the body from the front, and not a single wound of exit was reported. The bullets were lost in the tissues of the body except in a few reported cases in which symptoms revealed the resting place.

In spite of the opportunity for early treatment the mortality in the group seems high. The number of deaths in sixty-two patients was twenty-nine, a mortality of 47 per cent. In three patients who died the colon was the only viscus injured. Twenty-three patients succumbed to gunshot wounds (60 per cent) and six to stab wounds (31 per cent). There were twelve deaths in the first twenty-four hours (three patients dying on the operating table), and eight additional deaths in the first forty-eight hours, demonstrating that hemorrhage and shock were the main causes of mortality. Three patients developed peritonitis and died, a small incidence of this complication in view of the foul contents usually found in the peritoneum. There were three cases of pneumonia with one recovery.

The segments of the colon injured were as follows:

Cecum	4
Ascending colon	3
Transverse colon	30
Hepatic flexure	4
Descending colon	7
Sigmoid	5
Mesocolon only	3
Ascending and transverse colon	1
Transverse and descending colon	1
Mesoappendix	1
Abrasions of transverse colon	1
Abrasions of cecum and sigmoid	1
Evisceration only	2

The small intestine also was involved in twenty-nine cases, and the stomach in six cases. There were ten cases of liver injury, but none required suture. The kidney was injured in three patients, resulting in nephrectomy and death; splenectomy was performed in three patients, with one recovery. It was necessary to repair the tail of the pancreas in one patient who survived. In one-third of the patients the colon was the only abdominal viscus injured.

Combined tetanus and gas bacillus antitoxin was given routinely. All the patients were operated upon promptly; ether was administered in all cases except seven, when spinal anesthesia was employed. In several instances ample abdominal incision was already made by the patient's assailant; otherwise the abdomen was opened through a median or paramedian incision. Blood and blood clots were present in

amounts varying from a few drops to as much as 1,500 or 2,000 c.c. The first indication was to find and control bleeding points. Blood, food and feces were removed by suction or gentle wiping with saline sponges. In closing openings in the mesocolon care was excised to avoid interference with the blood supply of the gut. All perforations of the colon were closed without resection and anastomosis. Three patients had excision of segments of the small intestine. In one case 8 inches were removed, with a fatal outcome; in another case three inches were taken out, with recovery; and in another 2 feet of small intestine were excised, with recovery. Fine black silk and fine chromic catgut on atraumatic needles were used in intestinal suture. Peritoneal drainage was instituted in twenty-seven cases.

Blood transfusion was used six times, and no doubt more transfusions would lower the number of fatalities. Finding donors for this class of patients is difficult, and typing and matching takes time. It seems an ideal set-up for using the blood bank, but such a method has not met with favor in this institution on account of violent reactions.

CASE REPORTS

Eight cases are selected for detailed description:

Case I. Male, aged 25. The patient was brought into the hospital propped on an elbow with a large part of his stomach, 20 feet of small intestine and part of the transverse colon hanging out of an abdominal wound, said to have been made with a razor. Examination showed the incision extending from the tenth dorsal spinous process almost to the umbilicus. The patient did not seem to be in great pain or shock. His temperature was 101, pulse 66, respiration 24. Hemorrhage was moderate and a small amount of feces was seen oozing through an opening in the splenic flexure. The only other injury was a slight laceration of the capsule of the left kidney.

The patient was given 1,000 c.c. of distilled water with 5 per cent dextrose intravenously, and under ether anesthesia the exposed viscera were wiped clean with saline sponges, lacerations repaired with fine chromic catgut, viscera replaced, one Penrose drain inserted, and the abdomen closed with No. 1 chromic catgut and silk.

The patient recovered slowly, and five days later received 420 c.c. whole blood by the Rudder method. He was dismissed in good condition after three weeks.

Case II. Male, aged 22. The patient came immediately to the hospital after being shot in the left upper abdomen. The wound was 21 cm. long. The patient's general condition appeared to be good, and temperature, pulse and respiration were normal.

Under spinal anesthesia the incision was enlarged. The abdomen contained a large amount of free blood which arose from two superficial, non-penetrating wounds on the anterior surface of the transverse colon and two perforations on the posterior surface of the splenic flexure. The peritoneum was cleaned, perforations sutured, and the abdominal wound closed without drainage. Two days later the patient was operated upon, under spinal anesthesia again, for intestinal obstruction which was found to be in the terminal ileum. The obstruction was released, but the patient continued to grow worse, and died on the fifth day. Autopsy revealed an abdomen filled with pus, some bloody and some yellow, 800 c.c. being removed from the right subphrenic space, 500 c.c. from the left flank, 800 c.c. from the pelvis, and more pus from many pockets. No further intestinal perforations were discovered.

The final diagnosis was general peritonitis, bronchopneumonia, lobar pneumonia of the right middle lobe, and bilateral hypostatic pneumonia.

Case III. Male, aged 31. This patient entered the hospital with a recent bullet wound in the right upper abdomen. His condition was fair, and pulse, temperature and respiration were normal. There was slight abdominal rigidity, and he complained of pain in the region of the rectum.

Immediate operation was undertaken under ether. The bullet had cut the liver, the colon just below it, and then had lacerated the lower pole of the right kidney. The kidney, bleeding profusely, was delivered through the mesocolon, and was removed. The patient was unable to void and a retention catheter was inserted. At first he complained of severe pain

in his left leg and then all feeling disappeared. A roentgenogram showed fragments of lead in the back and a comminuted fracture of the third lumbar vertebrae. Before complete neurologic diagnosis was made the patient's abdominal wound broke open and it was necessary to resuture under ether anesthesia. He died the same day.

Case IV. Male, aged 28. This patient had received a stab wound in the right upper abdomen, and entered the hospital with a long loop of small intestine hanging out. On admission his pulse was 115, temperature 102 and respiration 28. Two thousand c.c. of normal saline were given intravenously at once, and 2,000 c.c. of distilled water with 5 per cent dextrose were administered the same way after operation and repeated often.

Under spinal anesthesia the wound was enlarged, and the abdomen found to contain a small amount of blood and considerable pork and collards. A small perforation in the anterior stomach wall was sutured with silk and a hole in the mesocolon closed with chromic catgut.

Recovery was slow. One month later a blood transfusion was given, followed by an operation under ether to close a suspected gastric fistula which proved to be three fistulae of the jejunum. These were repaired, and the patient recovered after six weeks.

Case V. Male, aged 39. The patient was admitted to the hospital one hour after he was shot in the left side of the abdomen. His condition was good, pulse 104, respiration 24, temperature 99. There was but little abdominal rigidity. Laparotomy through lower right rectus incision showed two holes in the hepatic flexure of the colon, which were closed with silk. A small opening in the liver did not bleed, and was not disturbed. Severe hemorrhage was coming from the left side of the abdomen so that a second incision was made which revealed a wound in the tail of the pancreas and a badly lacerated spleen. The injured pancreas was sutured and the spleen removed. A roentgenogram made two days after admission showed a comminuted fracture of the right ilium. The patient was dismissed, well, after thirty days.

Case VI. Male, aged 38. The patient entered the hospital two hours after receiving a gunshot wound of the abdomen. There was a small opening 2 cm. to the right of the umbilicus. His condition was good, pulse 80, respiration 24, temperature 24. He was taken immediately to the operating room, and under ether, a right rectus incision was made. A small amount of free blood was found in the peritoneal cavity. Exploration demonstrated a perforating wound of the terminal ileum, two openings in the transverse colon and a slight laceration of the liver which was not bleeding. The injured intestine was repaired and the abdominal wound closed without drainage.

Fluids were administered intravenously and convalescence was satisfactory until the fifth day when the temperature rose to 104. A tender, fluctuating mass was discovered just above the crest of the right ilium, and pus was aspirated. Incision exposed 300 c.c. of thick, foul pus behind the ascending colon, communicating with a perforation which was overlooked during the first operation. The abscess cavity extended back to the sacroiliac joint where the bullet had entered the bone without injury to other tissues. There was considerable bleeding, and it was necessary to make a second incision posterior to the first one in order to obtain good exposure. The wound was packed with iodoform gauze and closed loosely. The patient recovered after thirty-two days.

Case VII. Male, aged 27. One hour before admission the patient was shot five times in the chest wall, abdomen and left arm. The penetrating chest wound caused hemopneumothorax, but did not require operative interference. Pulse was 108, temperature 99, and respiration 24; the patient was in moderate shock. At first he felt no pain, then severe abdominal pain and nausea. The bullet involving the abdomen entered the right flank, just above the crest of the ilium.

Five hundred c.c. of gum acacia were given and the abdomen was opened under ether, revealing a moderate amount of free blood. Two perforations were found in the cecum and ten in the middle portion of the jejunum. The wounds in the cecum were sutured with fine chromic catgut, and 3 inches of the jejunum were excised to remove the lacerated portion, end-to-end anastomosis being performed. After operation 500 c.c. of blood from a bank donor were administered; normal saline solution and 5 per cent dextrose in distilled water, in 2,000 c.c. amounts, were repeated at frequent intervals.

Six weeks later intestinal obstruction developed and was confirmed by a roentgenogram

showing many fluid levels. Laparotomy revealed a loop of small gut bound down by adhesions. The outcome was good and two months after the first operation a third incision was made to drain an abscess of the abdominal wall. The patient was dismissed in satisfactory condition after eighty-two days in the hospital.

Case viii. Male, aged 23. According to the history, the patient was "cut with knives while attempting a hold-up." He was drunk and in shock. There was evisceration from a large gash in the right side of the abdomen. A sucking wound was present in the right chest and another in the left chest, in addition to several minor lacerations. Pulse was 120, temperature 96, respiration 40, blood pressure 80/60. Under ether-nitrous oxide-oxygen anesthesia, a mass of protruding omentum was removed. Three penetrating abdominal wounds were discovered. From one of the larger ones 4 feet of jejunum and 1 foot of transverse colon eviscerated. Feces escaped from several large wounds in the colon. There were ten to fifteen scattered lacerations of the jejunum. All the injuries were repaired, the operation consuming one hour. As the abdominal wall was being sutured the patient expired on the operating table. Hemorrhage appeared to be slight. The cause of death was given as shock.

SUMMARY AND CONCLUSIONS

1. In gunshot and stab wounds of the abdomen in civil practice the colon is involved in 22 per cent of the cases. The colon alone is injured in 33 per cent of the cases.

2. Hemorrhage and shock are the commonest causes of death. Immediate blood transfusion is indicated in the majority of cases. It is rarely necessary to resect segments of the colon.

3. In a series of sixty-two patients the mortality was 47 per cent. Gunshot wounds are twice as often fatal as stab wounds.

INDICATIONS AND TECHNIQUE OF COLOSTOMY

VERNON C. DAVID, M.D.

Chairman, Department of Surgery, Rush Medical College

CHICAGO, ILLINOIS

IN 1710, Littré suggested the operation of colostomy with the object of formation of an abdominal anus after he had observed the death of an infant six days after birth due to a congenital deformity of the rectum which prevented defecation. Pillore carried out a successful cecostomy in 1776. It was not until 1783 that Dubois performed the operation of iliac colostomy proposed by Littré, but his patient died. Duret in 1793 performed the first successful left iliac colostomy in an infant with congenital absence of the rectum. Considerable discussion arose as to the merits of a lumbar colostomy which was championed by Amussat and which he successfully carried out in six patients. Baudens in 1842 suggested the oblique lateral abdominal incision, which is now commonly used.

The indications for colostomy are now rather numerous and the operation may be made as a temporary or permanent opening. The most important indication is to relieve obstruction and in this instance the colostomy may be temporary if at a later date the obstruction can be relieved, or permanent if an inoperable obstruction is present. Carcinoma at the rectosigmoid or flexures of the colon accounts for the large majority of these cases.

Temporary colostomy is commonly performed as part of an operative procedure such as the Mikulicz operation or the Rankin obstruction resection of the colon. Colostomy is also temporarily used in diverting the fecal stream from inflammatory or other lesions distal to the colostomy. Among these conditions are intestinal vesical fistulae resulting from diverticulitis, trauma, infections, or on a congenital basis. Temporary colostomy is also occasionally indicated in advanced rectal stricture, narrowing of the sigmoid from inflamed diverticula, or as a decompressing procedure preliminary to operations on the bowel distal to the colostomy as certain plastic procedures on the rectum.

Permanent colostomy is most commonly performed as a necessary part of removal of the terminal colon and rectum for carcinoma or to relieve obstruction in inoperable growth of the rectum or sigmoid as well as in far advanced strictures of the rectum so commonly seen as in advanced lymphogranuloma inguinale of the rectum.

The types of colostomy vary, depending on its purpose. End colostomy is performed after removal of the rectum or in some instances preliminary to it. The distal end of the bowel is brought out through a left or right gridiron muscle splitting incision for a permanent abdominal anus.

Colostomy in continuity is carried out in the sigmoid loop or transverse colon as a temporary or permanent colostomy without complete division of the bowel wall. Peritoneum, fascia, or skin (Fig. 1) is sewed or a glass rod is placed under the bowel through its mesentery to keep the bowel well up on the abdominal wall and to produce a spur or partition between the afferent and efferent loop to divert the fecal content from the efferent loop out onto the abdominal wall.

Another commonly used type of colostomy is performed in the Mikulicz operation or the Rankin obstruction resection of the transverse colon, splenic flexure, descending colon, sigmoid loop, or rectosigmoid junction. After mobilization of the bowel to be resected and division of its gland bearing mesentery, the affected bowel is exteriorized and the abdominal wall sewed about the afferent and efferent loops of colon. The bowel containing the

growth with its detached mesentery is then removed leaving in the abdominal wall the adjacent afferent and efferent loops of

The technique of performance of these procedures varies considerably, many surgeons having their own favorite methods of

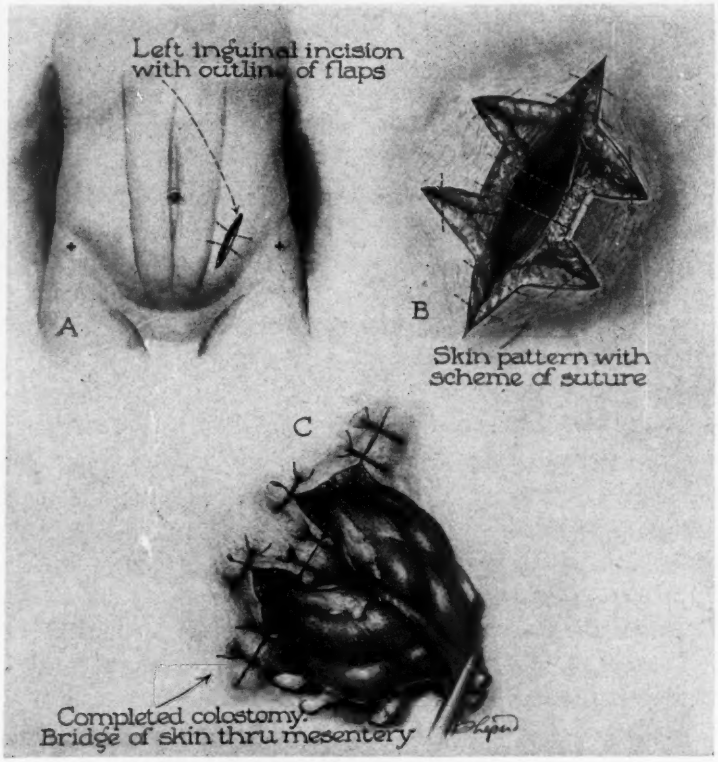

FIG. 1.

healthy bowel. This is a temporary colostomy and is followed by closure of these two loops at a subsequent operation. The object of this type of colostomy is to prevent peritonitis by extraperitoneal division of the colon. It is a most valuable procedure and has materially lowered the mortality of resection of the left half of the colon.

Lastly, a gas vent may be made in the cecum or transverse colon to relieve the symptoms of acute obstruction by drawing out a part of the circumference of the bowel and introducing into it a Pezzer catheter which is held in place by a linen purse-string suture. This procedure does not divert all of the fecal stream but is a gas vent and is useful as a temporary procedure in acute obstruction of the colon or to prevent distention after operations where tension on suture lines distal to it is advisable.

procedure. To avoid an encyclopedic discussion, a few principles of technique will be discussed and some details peculiar to our own fancy will be given.

The most important principle in establishing a successful colostomy is to mobilize freely the bowel which is to be used. In a fat individual with a short mesentery and an obstructed bowel this may be extremely difficult. Mobilization is accomplished by division of the lateral peritoneal attachments of the colon which allows the bowel to be drawn toward the midline and to be lifted up from the posterior part of the peritoneal cavity without interference with its blood supply. This procedure is essential to the successful performance of an obstruction resection operation as well as to colostomy in continuity, for the bowel must lie well above the skin without tension. When this is accomplished, suture of the bowel to any part of the abdominal

wall is unnecessary and indeed dangerous as tension on the sutures cut out and may result in leakage. Wherever possible, colostomy should be done through a lateral muscle splitting incision such as is used in appendectomy, because the bowel is held in place as it comes through the internal oblique muscle, the incision is small and less likely to become infected, postoperative hernia through the incision is less likely, and prolapse of the colostomized bowel is less frequent. The question of greater control of fecal evacuation by reason of muscle encircling the bowel is less certain, as no colostomy that I know of is entirely controllable.

In colostomy in continuity it is imperative that the mesenteric attachment of the bowel be kept well above the level of the skin to produce a spur for diversion of the fecal stream from the distal or efferent loop. As has been said, peritoneum, fascia, or skin can be sewed beneath the bowel through a small opening made in its mesentery. A glass rod cannot be worn permanently with comfort. Our practice is to use skin taken from both sides of the incision and sewed beneath the bowel. (Fig. 1.)

The bowel making the end colostomy must be well mobilized so that 1 to 2 inches of bowel protrudes above the skin without tension. The appendices epiploicae are drawn out with the bowel and tend to hold the bowel in position.

The dressing of the colostomy at the end of the operation is important for it can help in keeping the bowel well up on the abdominal wall and aids materially in prevention of infection of the abdominal incision. Two strips of iodoform gauze 3 inches wide are partially divided longitudinally to make pantaloon legs. The crotch of the pantaloon is laid against the bowel wall and the legs encircle the bowel so that the bowel wall as it emerges from the skin is everywhere in contact with the gauze. Over this iodoform gauze are placed gauze dressings 4 by 6 inches, which are heavily covered with zinc oxide paste. The paste side is down and these are latticed around the bowel over the iodoform gauze and completely covering the skin. They make a grease watershed, shielding the wound from feces and at the same time make an adherent dressing which sticks not only to the iodoform gauze and surrounding skin but to the bowel wall itself. The dressings which get dirty on the top shield the abdominal incision and should be left in place a week, when they are removed and the skin stitches are taken out. This procedure, which is simple to use, effectively prevents infection of the abdominal wall in most cases.

Lastly, we believe an important principle to observe is early opening of colostomies. When the colostomy is kept closed for two to five days the patient is uncomfortable from gas pressure. Tension on the abdominal wall stitches results if the colostomy is done coincidentally with a bowel resection, which favors evisceration. Of real importance is the danger of raising intra-intestinal pressure with the risk of causing a perforation of a diverticulum of the bowel which is so commonly present in patients of cancer age. That this danger is not theoretical is evidenced by a number of these accidents which we have reported elsewhere.* Consequently, end colostomies made in conjunction with one stage abdominoperineal resection of the rectum are opened at the termination of the operation and a catheter inserted into the bowel. The next day if gas is not passed spontaneously the bowel is gently irrigated with warm salt solution, 3 to 4 ounces at a time, until gas is passed. Colostomies in continuity, which often are not completely obstructed, and the clamped ends of the bowel in obstruction resection operations are not opened for twenty-four hours, when the same procedure is carried out.

In introducing a catheter into the bowel for a gas vent, a piece of the bowel wall is brought out onto the skin, the abdominal

* David, V. C., and Gilchrist, R. K. The complicating effects of diverticulitis of the colon upon abdominal surgery and especially upon surgery of the large bowel. *Ann. Surg.*, 107: 801 (May) 1938.

wall is closed about it, the iodoform gauze and zinc oxide dressing is applied, and then the catheter is inserted into the bowel. This insures immediate decompression of the bowel without danger of soiling the peritoneum or abdominal incision.

The proper after-care of a colostomy is most important for the patient's comfort. Colostomies in the cecum or right side of the colon are much more difficult to handle due to the liquid content of the bowel. As most colostomies are on the left side of the colon and the feces are semi-solid, a system of care can be worked out so the patient does not lose more than one-half hour a day in the management of his colostomy. The diet is arranged so that the patient has slightly constipated movements. After breakfast the patient lies in a semi-reclining position, as in the bathtub. He threads an 18 French catheter through a baby bottle nipple so that the end of the catheter protrudes through the sucking end of the nipple for about 4 inches. The vaselined catheter is inserted into the colostomy followed by the nipple up to the flared out portion. This acts as a valve which is usually water tight. A one and a half pint enema of plain cool water is now taken. The catheter is withdrawn, the patient sits up, has his bowel movement into a basin. Following the enema the colostomy is surrounded by vaseline gauze, dry gauze covers that, and a light elastic girdle is pulled up over the dressing. These girdles can be purchased for two dollars and are made by Bauer and Black. If the patient can arrange his diet to avoid diarrhea he will be free of bowel movements for twenty-four hours and can carry on his work as any normal individual. This procedure eliminates complicated apparatus and, when mastered, robs a colostomy of many of its disadvantages.

The mortality of colostomy is not negligible and is concerned with the pulmonary and vascular complications incident to age and carcinoma as well as to the occasional local complications, as wound infection, death of the colostomied bowel because of insufficient blood supply, ileus due to adherence of loops of small bowel to the colostomy wound, and peritonitis from technical errors or perforation of diverticula proximal to the colostomy.

CECOSTOMY—INDICATIONS AND TECHNIQUE

ROSCOE R. GRAHAM, M.B.

Assistant Professor of Surgery, University of Toronto Medical School

TORONTO, ONTARIO

THE basis of this discussion is an analysis of the histories of ninety-six patients upon whom the author has performed cecostomy for either acute or chronic obstruction of the colon during the last twenty years. Study of these cases has been of unusual interest of the chronicle of the procedures carried out really is the history of the evolution of surgical operations upon the colon during this period.

The principle of decompression of obstructed lumina in various parts of the body has long been known. The earliest application was in decompression of the urinary bladder distended as a result of obstruction of the urethra. The extent and the degree of the pathologic and biochemical changes which inevitably accompany the obstruction of all hollow tubes in the human organism has been but slowly and as yet probably quite inadequately recognized. It is in the application of this principle in the treatment of acute obstruction of the colon that a blind cecostomy becomes an invaluable procedure. By a blind cecostomy is meant a cecostomy which is performed without a coincident exploratory laparotomy. The administration of a barium enema prior to the operation will in most instances localize the obstruction.

That the principle of decompression finds complete expression in blind cecostomy is substantiated by the fact that in this series there were thirty-three instances of acute obstruction of the colon which were submitted to a blind cecostomy, with but two deaths from obstruction, a mortality of 6 per cent, which is unusually low in any group of cases suffering acute intestinal obstruction. Following are the details of patients who failed to recover from the obstruction: (1) a male, aged 74, obstructed for eight days, who died of peritonitis; (2) a female, aged 56, whose cecum was so distended that gangrenous patches were present, one of which perforated during the operation. A third patient died some weeks following the cecostomy, from inanition due to very extensive local disease with multiple metastases.

It thus becomes obvious that as a simple safety measure a blind cecostomy offers an admirable solution of the emergency resulting from an acute obstruction of the large bowel. It is felt that if this procedure fails to save the patient from the disasters of obstruction, no other operative procedure would have succeeded. The details of the three operative deaths cited above would support this contention.

The lesions for which cecostomy has been carried out in this group of patients are shown in Table 1, and provide an interesting comment on our therapy during this period.

TABLE 1

Carcinoma of the colon	74
Diverticulitis of the sigmoid	8
Sigmoid obstruction due to band	2
Volvulus of the cecum	1
Perforated appendix	2
Bullet wound colon	1
Colitis, idiopathic	2
Colitis, tuberculous	1
Benign tumor with intussusception	2
Gastrojejunocolic fistula	3
Total number of patients having cecostomy	96

It becomes obvious from this table that cecostomy is most useful in the malignant lesions of the colon. That it is valuable in this group means that its value lies in the relief of obstruction of the colon, either acute or chronic.

The distribution of the carcinomata in the colon for which this procedure was carried out is shown in Table II.

TABLE II
DISTRIBUTION OF CARCINOMATA

Ascending colon	1
Transverse colon	8
Descending colon	9
Sigmoid colon	49
Rectum	7

A most valuable observation was made in one case, where the obstruction of the transverse colon was due to an intussusception of benign submucous lipoma. The cecostomy adequately relieved the abdominal distention and an abundant fecal discharge came from the cecal stoma. Despite this the patient suffered a persistence of the cramp-like abdominal pain. The significance of the relief of the obstruction without coincident relief of the crampy abdominal pain was not appreciated until a laparotomy was performed. We experienced the same phenomenon in a second case, and, correctly interpreting it, were able to proceed with the second stage of the operation as soon as the abdominal distention and the biochemical upset accompanying the obstruction was relieved. This is important with such a diagnosis, as undue delay makes the second stage of the operation more hazardous because of the edema and potential infection which persists about the intussusception.

While only three deaths occurred when a blind cecostomy was performed, five died when the cecostomy was coincident with a laparotomy. These five patients died of peritonitis. This is ample evidence of the rationality of the aphorism, "In all abdominal emergency operations, carry out only the most simple and atraumatic procedure directed solely to saving life, dealing only with the cause of the emergency." It might be said, in the incidence of a carcinoma of the sigmoid accompanied by acute obstruction, that the neoplasm of the colon was the cause of the emergency. This we question. The carcinoma was present for many weeks, with very slight disturbance to its host. However, the onset of obstruction rapidly creates a new symptomatology as a result of the associated pathologic and biochemical changes. This rapidly changing clinical picture causes the patient to seek aid: therefore the obstruction creates the emergency.

A second aphorism is worthy of remembrance in acute abdominal disease: "Assess the clinical picture carefully in order to ascertain the rôle which the various factors contribute in creating the emergency." One would defer operation for carcinoma of the breast in a patient who when first seen was also suffering from acute appendicitis. This latter disease created the emergency, and must be dealt with adequately as a primary maneuver. With similar logic, one must defer operation on a carcinoma of the colon until the obstruction is adequately relieved. Granted that an accurate diagnosis of acute obstruction of the colon may be arrived at, it is submitted that a blind cecostomy is the most simple, safe and satisfactory primary procedure which will adequately solve the problem.

In addition to the pitfall where the chronic obstruction was due to the intussusception of a submucous lipoma, we have encountered a second lesion of the large bowel in which a blind cecostomy alone would be inadequate to control the emergency. We refer to a volvulus of the sigmoid colon. Our practice of using *x*-ray examination with a barium enema as a diagnostic aid will, if correctly interpreted, lead to an accurate diagnosis of this lesion. In the *x*-ray examination the great mass of the barium in the colon lies in the right upper quadrant. This observation, made in our department of radiology, has been reported by Hall.[1] With this diagnosis, the need for a laparotomy is obvious, but a coincident cecostomy of the type shown in Figure 3 is of real value in completing the decompression of the colon after the volvulus is adequately dealt with. The coincident laparotomy and cecostomy do not carry the potential danger of peritonitis, as is the case where the obstruction is due to

an ulceration carcinoma with associated edema.

Occasions arise, however, when one is confronted with the necessity of making the diagnosis of intestinal obstruction in a very ill patient suffering from ill-defined, bizarre abdominal systems, under circumstances where all the physical aids to diagnosis such as the *x*-ray and other laboratory facilities are not available. The diagnosis of intestinal obstruction can usually be made. The site and cause are often difficult to determine. If the obstruction be inflammatory, the appendix is the most common offending organ. If the site of the obstruction be in the small bowel, and the common hernial sites are eliminated, an exploratory laparotomy is essential. If the site be in the colon, and volvulus of the sigmoid can be eliminated, an exploratory laparotomy is highly undesirable. This is made evident by this study, as in this group of seventy-four cases of carcinoma of the colon accompanied by obstruction there were twenty-two deaths, but only eight of these could be attributed to the phenomena accompanying obstruction and only three of these died following a blind cecostomy. Five died when the cecostomy was accompanied by an exploratory laparotomy, and in each instance death was due to peritonitis. The source of the peritonitis we believe to be infection in and about the edematous, obstructed bowel wall. The trauma incidental to the exploration, even though gently carried out, is sufficient to break the barrier and release the infection. It is very similar to the waterproof qualities of a tent in a rainstorm. If a finger touches the inside of the tent, a break develops. We have been impressed with the fact that patients suffering from obstruction of the colon tolerate even the most simple operative procedures very badly. The incidence of streptococci in and about the edematous, obstructed bowel has been admirably shown by Garlock and Seley,[2] where cultures taken from the various sites about the lesion yielded a high incidence of hemolytic streptococci. Their suggestion to bring such patients under control by sulfpyridine before operation would appear to be very sound.

It thus becomes obvious that in circumstances where facilities are such that one is unable to arrive at an accurate localization of the obstructing lesion, the operative procedure must not only relieve the obstruction, but do so without adding any new element of danger such as accompanies the exploratory laparotomy when the obstruction is due to a carcinoma of the colon. We have shown a high incidence of peritonitis as an accompaniment of this procedure.

Under such circumstances our method of procedure is to operate with a spinal anesthetic and explore the abdomen through a McBurney split muscle incision. The cecum and terminal ileum are located. If the terminal ileum is not dilated, then the obstruction is in the small bowel, and a paramedian incision is made. No harm has been done, and but a few minutes have been consumed by making the McBurney incision. If, on the other hand, the cecum and terminal ileum are distended, the site of the obstruction is distal to the cecum and the obstruction will be relieved by a blind cecostomy without any of the increased hazards which would have accompanied a coincident laparotomy. It has been our custom to bring out a piece of cecum, which bulges into a circular mass approximately 1 inch in diameter. This segment of cecum is fastened to the skin with four interrupted catgut sutures. Failure to sew the cecum to the skin is often followed by a retraction of the cecum to a below-skin level. This renders the procedure less efficient, and is almost invariably accompanied by infection of the abdominal wall. The abdominal wound is closed about the protruding piece of cecum with a few interrupted catgut sutures. The details of this procedure are illustrated in Figure 1.

No attempt at an elaborate closure of the abdominal wall is made at this time, as we recognize a second operation will be necessary to close the cecostomy, and at

this time the abdominal wall may be adequate repaired. After an experience which involves many types of cecostomy operations designed to obviate the necessity for subsequent closure, we believe that the efficiency of the procedure here described, where a mucocutaneous fistula is established, provides so much more efficient decompression as to justify the additional operation necessary for its closure. We are insistent that no sutures be placed in the bowel except those uniting it to the skin. To suture the bowel to the subcutaneous structures is to invite infection of the abdominal wound.

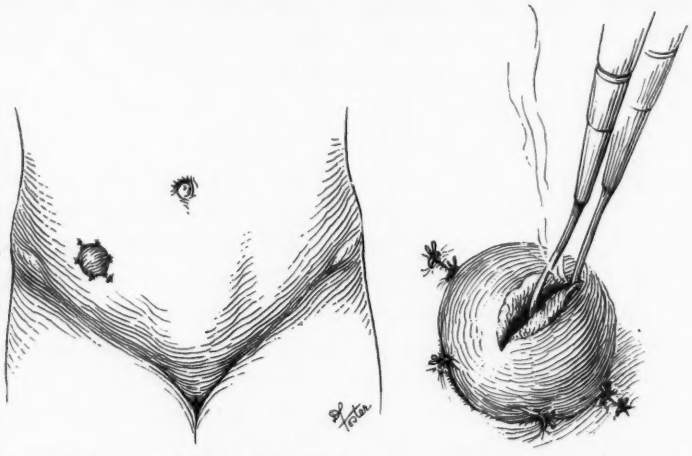

Fig. 1. Position at which the portion of cecal wall is brought out in the right iliac fossa. The cecum is sutured to the skin by four interrupted catgut sutures. The incision is closed above and below the bulging portion of cecum. The opening in the cecum made with the actual cautery of such proportion in relation to the cecum as illustrated. This opening is placed at right angles to the long axis of the bowel.

The cecum is not opened for twelve to twenty-four hours following the operation. During this time the biochemical upset is corrected by the administration of glucose, salt, water and blood as indicated. It is amazing how much such patients improve during this period, even though the obstruction is not relieved.

The cecum is opened with the actual cautery. The incision is placed at right angles to the long axis of the bowel. One rarely has to tie any blood vessel in the bowel wall, although provision should be made to do this at the time the cecum is opened. We then immediately begin the instillation of oil into the cecum by means of a small rubber catheter. Because it is cheap, efficient and readily available, we use raw linseed paint oil, injecting 3 to 4 ounces two to four times in the twenty-four hours, the amount and interval depending upon the degree of return of the oil through the cecostomy, which in turn is in direct ratio to the completeness of the obstruction. As the edema about the carcinoma subsides, the oil appears at the rectum, and then saline irrigations are carried out through the cecostomy and through the rectum. This maneuver, together with a low residue diet, is efficient in a large percentage of cases in keeping the colon empty and permitting the subsidence of the edema in the bowel wall and about the tumor.

Because we plan later to repair the abdominal wall, these patients are allowed to be up and about the ward in forty-eight to seventy-two hours after the operation. This, we believe, is a real asset, as the general muscle tone and exercise tolerance is maintained during the preparation, and the patient is thus much better able to withstand the next operative procedure.

How long should the interval be between the cecostomy and the resection of the

obstructing lesion itself? This question is answered by an analysis of the deaths which have occurred after this second stage. There were thirteen deaths in this group where, although the cecostomy was effective in relieving the acute obstruction, the patient succumbed following resection of the growth. In all but two instances, death resulted from infection.

In reading the histories of these cases, one is impressed by the repetition of the statement in the operative note: "Bowel wall still shows edema," or "Bowel contains fecal content." These statements are susceptible of two interpretations: first, the interval between the cecostomy and the second stage was too short to permit adequate preparation; or the obstruction was so nearly complete that some additional procedure was necessary to enable the bowel to remain empty and free from edema. In no instance should the resection be undertaken less than two weeks after the cecostomy. If the cecum at the time the cecostomy is performed shows evidence of gross edema, an interval of at least three, and preferably four weeks should elapse between the two stages.

Even with the most painstaking and apparently adequate preparation, when the abdomen is opened for the second stage, one is occasionally chagrined to find residual edema in the bowel wall and about the growth. Under such circumstances one should never attempt any form of anastomosis in continuity. Rankin's[3] obstructive resection of the Mikulicz type may be used. If, however, the lesion be in the left colon, we believe there should be an additional operative stage, and, despite a limited experience, we are most favorably impressed with Devine's[4] defunctioning transverse colostomy. This permits of the most adequate preparation of the distal colon.

If during an operative procedure the colon be involved or wounded, and one wishes to provide a safety valve as a temporary procedure, the use of a Pezzer catheter witzelled into the cecum, as illustrated in Figure 2, is an admirable procedure. This may be carried out through the laparotomy wound. This maneuver permits the escape of gas and fluid content of the cecum, preventing distention and is worthy of greater recognition than is generally accorded it. Witzelling the catheter where it lies between the cecum and parietal peritoneum, enable the catherer to be cut off at the skin level when the need for the cecostomy is past. The distal fragment will be passed per rectum and the fistula will heal readily. We have used this type of cecostomy in cases of gastrojejunocolic fistula, but the rod colostomy of the ascending colon, as suggested by Damon Pfeiffer[5] of Philadelphia is a more efficient and most valuable procedure.

In retrospect, and with the perspective of twenty years in the material presented by these cases histories, one is more and more impressed with a few simple fundamental and obvious truths in regard to obstruction of the colon, particularly when the obstructive lesion be carcinoma: firstly, our operative therapy in cases of acute obstruction must aim only at decompression of the colon, this to be achieved with the minimum of intraperitoneal manipulation; second, the colon must be kept relatively empty by non-residue diets and irrigations. This must be kept up for from two to four weeks, in order to permit the disappearance of the edema in the bowel wall and about the tumor; third, the biochemical balance of fluids and salts must be restored and maintained. The value of the proper proportion of glucose in saline and glucose in distilled water has been adequately presented by Coller and Maddock.

These three fundamental truths seem so obvious that stating them, much less repeating them, would seem superfluous, and yet how often have patients been sacrificed because of failure to completely and adequately grasp their import. In the presence of acute obstruction of the colon, a blind cecostomy fulfills adequately and simply the requirements of the operative

procedure, and it is in dealing with this problem that we have, in a blind cecostomy, a safe, simple and satisfactory method of combatting the emergency. If, when the second stage of the operative procedure is undertaken, the edema in the bowel wall or about the growth is not entirely relieved, or if the bowel is not adequately empty of feces, this is not necessarily a condemnation of the value of the cecostomy, but evidence that following the relief of the acute emergency, further and more efficient operative means should be employed to secure an empty

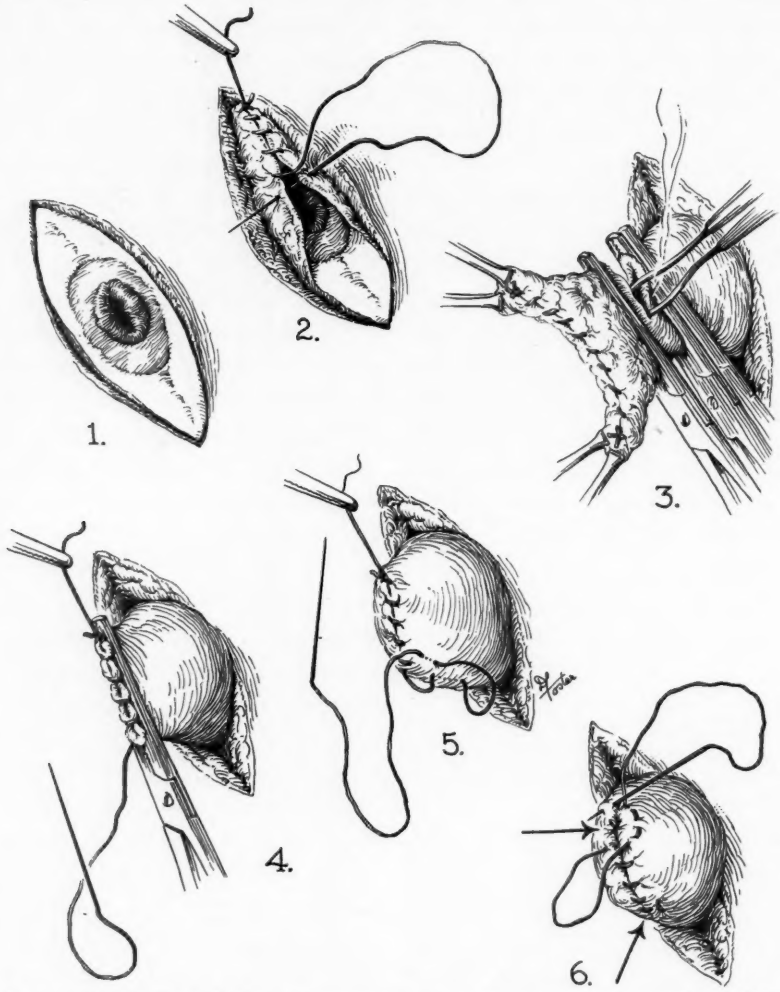

FIG. 2. Method of closing cecostomy. 1, cecostomy stoma, together with surrounding portion of cecum and skin scar isolated by an elliptical incision, which is carried down to the aponeurosis of the external oblique. 2, oversewing of this ellipse of skin, which serves to close the cecostomy stoma. The cecum is then mobilized and brought farther out of the wound, in order that the skin and stoma may be excised. This is accomplished by putting on three Kocher hemostats, leaving two and removing the third with the skin and stoma by means of the actual cautery. The more distal of the two remaining hemostats is removed, and the frill left is oversewn as shown in 4. A second row of sutures completes the closure. The method of closing the proximal and distal corners is shown in 5 and 6. The infolding stitch in 5 is efficient in burying the distal corner and the purse-string effectively closes the proximal corner. Between 2 and 3, gloves and instruments are changed, and after 6 the abdominal wall is smeared with BIPP and closed in layers with interrupted sutures.

bowel free from edema. The Devine colostomy does just this, and probably as experience increases, will become the second operative procedure when the lesion responsible for the acute obstruction is a carcinoma in the left large bowel. This should be seriously considered in all cases where saline does not run through the colon freely during the irrigations. This additional step would entail two further operative procedures—first, excision of the growth, with anastomosis, and second, coincident closure of the cecostomy and colostomy.

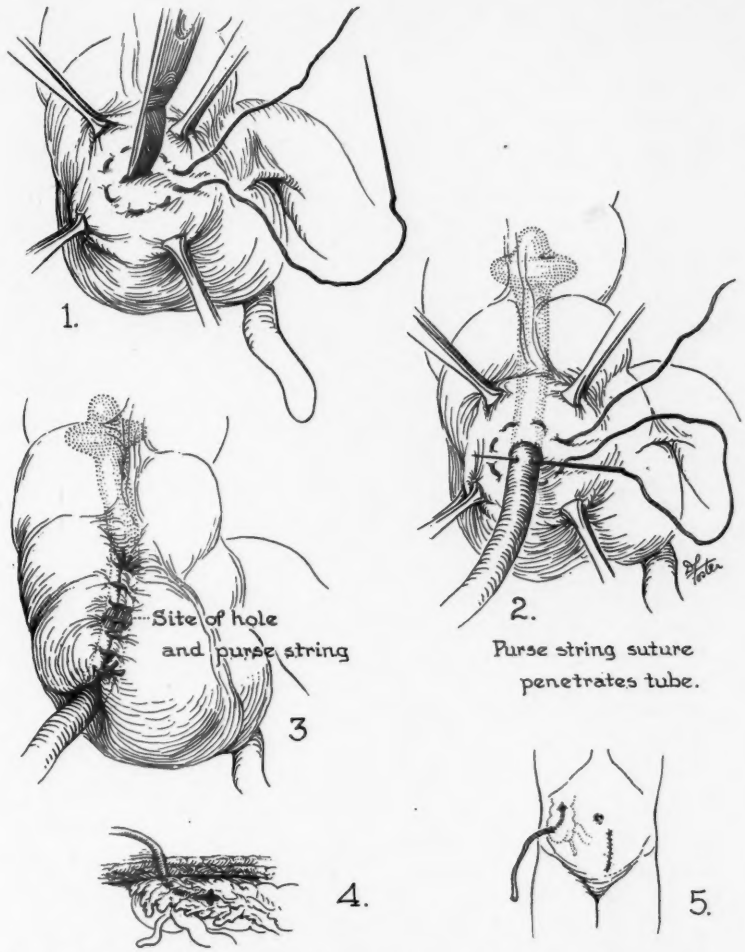
1.
2.
Purse string suture penetrates tube.
Site of hole and purse string
3
4.
5.
Tube pulled through omentum which is placed between cecum and parietal peritoneum.
Tube brought through stab wound – abdominal wall.

Fig. 3. Technique of cecostomy coincident with laparotomy. 1, insertion of a purse-string with the cecum held up by four Allis forceps. This prevents escape of fecal contents while an opening is made with a knife in the middle of the area outlined by the purse-string. Through this opening a Pezzer catheter is inserted for 2 inches, and is held at this level by including the catheter in the purse-string suture, as shown in 2. 3, the bowel oversewn proximal and distal to the insertion of the tube. The catheter is then brought through the omentum, which lies interposed between the cecum and parietal peritoneum. The catheter is then brought out through the abdominal wall at McBurney's point by means of a stab wound. These last two maneuvers are shown in 4 and 5.

The principle of multiple stage procedures is sound. We have been slow to appreciate and apply this principle, which has contributed so much to the safety and

efficiency of surgical operations upon the colon. That multiple stage procedures are time-consuming is no valid argument against their use. The procedures are much shorter than eternity, which may be the alternative time to which we condemn the patient.

How long should be the interval between resection of the obstructing lesion and the closure of the caecostomy? In only five of the ninety-six cases was the discharge from the cecostomy so insignificant that the patient elected to carry on without further operation. The shortest interval in this series was six weeks. It has been considered wise to defer closure for three months, in order to permit a complete subsidence of all the inflammatory reaction about the anastomosis. If, however, there is continuous gross soiling, which is most infrequent, with great discomfort to the patient, the cecostomy may be closed any time after six weeks, providing *x*-ray examination with a barium enema shows a good lumen at the site of the anastomosis, thus ensuring a disappearance of any obstruction from postoperative edema.

The details of the dissection which we carry out in closing the cecostomy are adequately presented in Figure 3. In most instances this can be carried out extraperitoneally. One need have no concern, however, if the peritoneal cavity be opened. Using the suggested technique which we have developed, there has been no case of peritonitis following closure. The incidence of infection in the abdominal wall has been negligible. The use of BIPP rubbed into the layers of the abdominal wall after excision of the scar tissue we believe to be of real value in preventing wound infection. If, when the bowel has been closed, as indicated in Figure 3, the peritoneal cavity has been opened, a continuous catgut suture closes the anterior peritoneal peritoneum. The internal oblique and transversalis muscles, as well as the aponeurosis of the external oblique, are united with a few interrupted catgut sutures, the skin being loosely closed with a few widely separated interrupted silk sutures. The patient is allowed out of bed in ten days.

CONCLUSIONS

1. In acute obstruction of the colon, a blind cecostomy offers a safe, simple and satisfactory means of combating the emergency.

2. The technique of sewing the cecum to the skin ensures efficient drainage of the cecum with a minimum of wound infection.

3. The patient is able to be out of bed within forty-eight to seventy-two hours of the operation, and muscle tone and exercise tolerance are maintained during the preparation for the subsequent operative procedure.

4. A minimum interval of two weeks should elapse between the cecostomy and resection of the tumor, longer intervals being required in direct ratio to the degree of edema at the cecum.

5. If at the second operative stage, edema of the bowel wall be still present, this is not a condemnation of cecostomy, but an indication to defer resection and carry out a procedure to more efficiently defunction the colon.

6. Closure of the cecostomy should be deferred a minimum of six weeks, and preferably for three months following the resection.

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LYMPHATIC DISTRIBUTION OF THE COLON AND RECTUM

W. W. Looney, M.D.

Professor of Anatomy, Baylor University College of Medicine

DALLAS, TEXAS

THE lymphatics of the entire gastrointestinal tract are so intimately interrelated that it becomes a rather tedious task for one to obtain a concise understanding of the lymphatic drainage of any one part without first surveying the lymphatics of the entire system. It will be necessary, therefore, in a discussion of the lymphatics of the colon and rectum to give, firstly, the general arrangement of the main groups of lymphatic glands in the abdominal and pelvic cavities and the ducts through which the lymph flows from the entire gastrointestinal tract to the cisterna chyli. Secondly, an attempt will be made to describe in detail the exact routes, so far as they are known, by which lymph flows from every subdivision of the large bowel to its final entrance into the main lymph channel. By this plan it is hoped that the reader may obtain a concise mental picture of the lymphatics of any given portion of the large gut independently of all other portions.

Originality is claimed only in the arrangement of the subject matter of this paper, and none whatsoever as concerns the material itself. Free use of statements and descriptions by a number of authors is made, and full credit given to each in a list of references at the end of the article.

GENERAL ARRANGEMENT OF THE LYMPH GLANDS IN THE ABDOMEN PROPER

There are four main groups of lymph glands in the abdomen proper, all of which are concerned either directly or indirectly with the drainage of the colon and rectum. In accordance with their relation to the abdominal aorta, they can be called the pre-aortic, the para-aortic (right and left lumbar) and the retro-aortic lymph glands.

The first, or pre-aortic group, is composed of three main subgroups, namely, the celiac group, the superior mesenteric group, and the inferior mesenteric group.

The celiac group, situated around the celiac artery in the upper part of the posterior abdominal wall and related to the abdominal aorta, consists of a variable number of glands. This group of glands may be further subdivided into a number of smaller groups corresponding to the chief branches of the celiac artery and their branches. It will not be necessary to discuss these groups of glands, since they do not concern us particularly in this paper.

The superior mesenteric group of lymph glands lies along the main stem of the superior mesenteric artery, in the root of the mesentery of the small intestine. These glands receive afferents from the glands associated with the several branches of the superior mesenteric artery, and will be described more fully below.

The inferior mesenteric group of lymph glands is situated along the stem of the inferior mesenteric artery. The glands of this group receive afferents from the smaller glands associated with the branches of the inferior mesenteric artery.

In addition to these three main groups of pre-aortic lymph glands, many glands are found lying upon the anterior surface of the abdominal aorta which cannot be said to belong to any one of the three groups described above. They merely serve as connecting glands for all the aortic groups.

The chief groups of celiac and superior mesenteric lymph glands give origin to efferent lymph ducts which unite to form the common gastrointestinal (common intestinal) lymph trunk. This large duct thus formed empties into the cisterna

chyli, whence the lymph flows into the thoracic duct. The inferior mesenteric lymph glands are drained into the para-aortic (lumbar) glands, especially the left ones. From here the lymph is carried by the lumbar trunks to the cisterna chyli.

The para-aortic lymph glands are situated along either side of the abdominal aorta, being much more numerous on the left side than on the right. They are commonly known as the right and left lumbar lymph glands. Those on the right side of the aorta are found chiefly behind the inferior vena cava.

A common lymph trunk issues from each group of para-aortic (lumbar) glands, and receives the name of right or left lumbar trunk. According to some descriptions these two ducts unite to form the cisterna chyli. The latter structure is placed upon the bodies of the first two lumbar vertebrae, between the aorta on its left and the vena azygos on its right.

The retro-aortic glands lie behind the abdominal aorta and are of interest to us in this discussion only indirectly, since they are concerned primarily with the lymphatics of the structures situated in and around the vertebral canal.

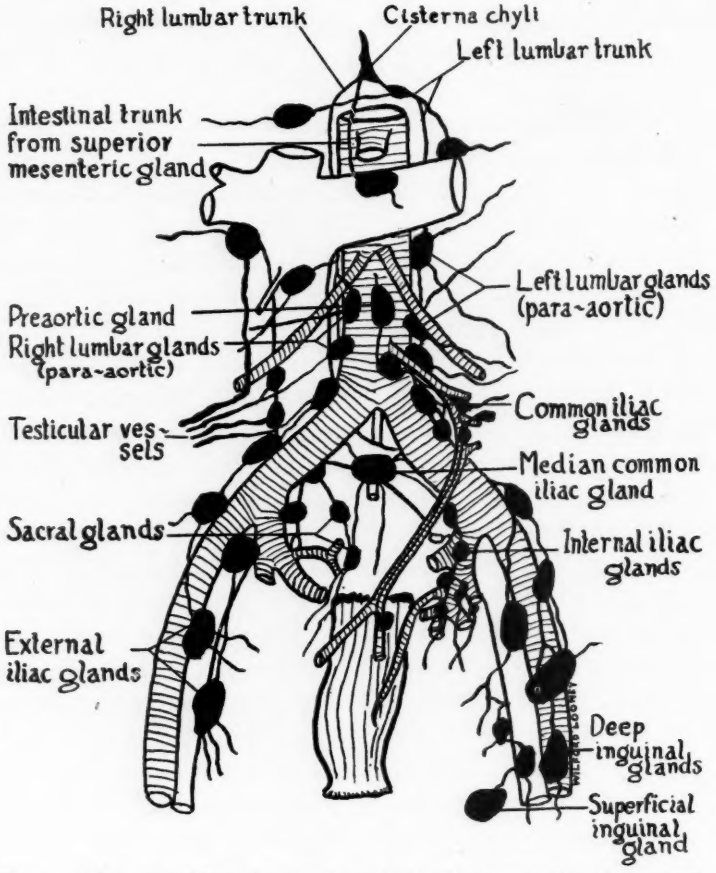

FIG. 1. Diagram of lymph vessels and glands of posterior abdominal wall and pelvis. (Modified from Cunningham.)

LYMPH GLANDS OF THE PELVIS

Like the lymph glands of the abdominal cavity, the lymph glands of the pelvis can be divided according to their relations to the main blood vessels. Thus we find three main groups of glands in the pelvis, each of which is associated with one or other of the three large arteries of the pelvis: (1) external iliac lymph glands, continuing upward the inguinal lymph glands; (2) internal iliac lymph glands, found in the

pelvis proper; and (3) common iliac lymph glands which are the proper connecting links between the first two groups and the aortic lymph glands.

There are many subdivisions of these three groups of lymph glands, especially of the internal iliac group. The subgroups of the internal iliac group are named according to their association with the various branches of the internal iliac artery, and for our purpose require no further description.

One small group—the sacral lymph glands—is, however, important because of its intimate connection with the rectal lymphatics. The lymph glands comprising the sacral group lie in the hollow of the sacrum, and their efferents pass to the common iliac and aortic lymph glands.

The external iliac lymph glands form three chains—lateral, intermediate, and medial—which lie along the external iliac vessels, and receive lymph vessels chiefly from the inguinal lymph glands. Their efferents pass to the common iliac lymph glands.

The internal iliac lymph glands are situated along the trunks of the internal iliac arteries. As stated above, many subgroups are found in association with the several branches of the internal iliac artery and with the pelvic organs. The efferent vessels of the internal iliac lymph glands empty into the common iliac lymph glands.

The common iliac lymph glands are the direct continuation upward of the internal and external iliac lymph glands. Several subgroups of the common iliac glands have been described according to the relations of the glands to the common iliac vessels. The efferent ducts of the common iliac lymph glands join the para-aortic (lumbar lymph glands).

LYMPHATICS OF THE CECUM AND APPENDIX

The lymphatic drainage of the cecum and appendix is accomplished by three sets of collecting vessels, namely: (1) an anterior cecal group; (2) a posterior cecal group; and (3) an appendicular group.

The anterior cecal lymph channels begin

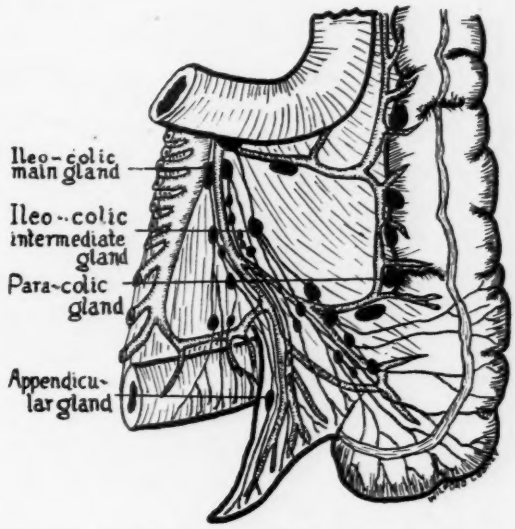

Fig. 2. Lymph vessels and glands of the cecum and appendix from behind. (Modified from Jamieson and Dobson; Cunningham.)

in the submucous coat of the cecum and drain all its anterior surface. After traversing one or two small nodes these ducts pass to the main group of ileocecal glands. From here the lymph passes through ducts to the superior mesenteric lymph nodes.

The posterior cecal lymphatics are very similar in their origin to the anterior. They drain the posterior surface of the cecum, and finally terminate, like the anterior ducts, in the ileocecal lymph glands and in the superior mesenteric lymph glands.

It is said that both sets of cecal lymphatics communicate freely with the lymphatics of the base of the appendix but not at all with the lymphatics of the rest of that organ.

The lymphatics of the vermiform appendix are especially well developed, and subserve an important rôle in infections of the appendicular region. The small lymphatic capillaries of the appendix begin in the submucous and peritoneal coats and communicate freely with one another through the muscular coat. Collecting trunks from these capillaries are formed

which enter the mesoappendix and follow the course of the appendicular vessels.

The main lymph trunks of the appendix end in several groups of glands:

(*c*) It is stated that ducts from the appendix join the lymphatics of the ovary. According to some observers this can occur only when the mesoappendix is prolonged

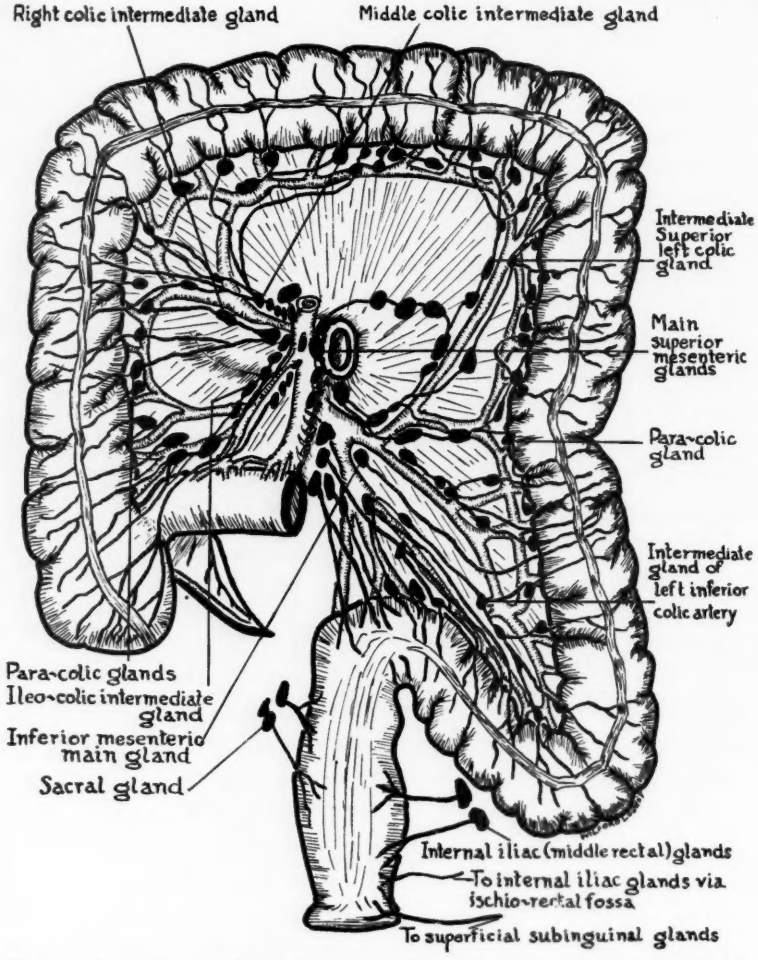
Right colic intermediate gland
Middle colic intermediate gland
Intermediate Superior left colic gland
Main superior mesenteric glands
Para-colic gland
Intermediate gland of left inferior colic artery
Para-colic glands
Ileo-colic intermediate gland
Inferior mesenteric main gland
Sacral gland
Internal iliac (middle rectal) glands
To internal iliac glands via ischio-rectal fossa
To superficial subinguinal glands

Fig. 3. Lymph vessels and glands of the large intestine. (Modified from Jamieson and Dobson; Cunningham.)

(*a*) Into the appendicular glands (ceco-appendicular). These are two or three small glands which lie in the mesoappendix, in the angle between the appendix and cecum, and behind the terminal part of the ileum. The ducts from these glands join the ileocecal glands which lie along the course of the ileocecal artery. From here the lymph passes to the superior mesenteric lymph glands.

(*b*) Directly into the ileocecal glands, which are, in their turn, connected with the superior mesenteric lymph glands. The ileocecal glands lie along the course of the ileocecal artery.

to the broad ligament. The prolongation of the mesoappendix, when it occurs, constitutes Clado's ligament.

Tixier and Viannay pointed out that the appendix has a double insertion—cecal by its root, and ileal by its mesentery. Hence, the lymphatics of the base of the appendix follow those of the cecum, while the ducts of the rest of the appendix pass more directly to the superior mesenteric lymph glands. Practically all the ducts of the appendix run behind the terminal part of the ileum.

It has been stated that the lymphatics of the appendix may extend to the pleura

through the lymphatics of the peritoneum which connect with the lymphatics of the pleura through the diaphragm (Campbell).

Communications have been described as existing between the appendicular lymphatics and those of the broad ligament of the uterus as well as with the iliac glands. The more recent observations have failed, however, to confirm the existence of any direct connections with these structures, and pathologic conditions of the broad ligament and iliac glands associated with acute appendicitis may perhaps be due to the dissemination of the infection through the subperitoneal network by way of the so-called appendiculo-ovarian (Clado's) ligament (Piersol).

LYMPHATICS OF THE COLON AND RECTUM

There are comparatively few lymph glands along the ascending colon. When present, they lie along the medial margin of this portion of the large gut and receive some of the lymph channels from its anterior and posterior surfaces. From these paracolic lymph glands, ducts pass along the course of the right colic artery, communicating freely with the right colic lymph glands, and, finally, terminating in the superior mesenteric group of lymph glands.

The lymphatics of the right flexure of the colon and the right two-thirds of the transverse colon, after traversing the paracolic (or mesocolic) glands situated along the upper border of the transverse colon and between the two layers of the transverse mesocolon, pass to glands associated with the branches of the middle colic vessels. From the middle colic lymph glands the lymph is carried by channels to the superior mesenteric lymph glands.

In the area of distribution of the inferior mesenteric artery—left one-third of transverse colon, left flexure, descending colon, pelvic colon, and upper portion of rectum—the lymphatics of the large bowel pass to the epicolic and paracolic lymph glands. From these glands ducts pass into the inferior mesenteric lymph glands, situated along the stem of the inferior mesenteric artery. The lymphatics of the inferior mesenteric group of glands join the left para-aortic (lumbar) lymph glands.

The lymphatic drainage of the left one-third of the transverse colon and the left flexure, because, of its peculiar arrangement, requires special mention. These lymph vessels are not "direct vessels" beyond the intermediate gland group. One set of lymph vessels follows the course of the inferior mesenteric vein to the superior mesenteric group of lymph glands. It is stated that a few small peritoneal vessels from the left flexure of the colon run upward in the greater omentum and thence through the gastrosplenic ligament to the lymph glands situated near the hilum of the spleen (Cunningham).

LYMPHATICS OF THE RECTUM AND ANUS

There are three lymphatic zones of the rectum and anus: (1) An inferior zone, corresponding to the anal integument, in which the capillary networks, both superficial and deep, are extremely abundant, and from which from three to five collecting vessels on either side pass to the inguinal region and end in the medial superficial inguinal nodes. (2) A middle zone, corresponding to the transition zone of the epithelium—that is, with the mucous membrane below the columns of Morgagni. Here the network is coarse, and has its meshes arranged vertically; its ducts drain partly into nodes situated along the inferior and middle hemorrhoidal arteries, and partly pass to the nodes of the mesorectum, situated along the superior hemorrhoidal artery and known as the anorectal nodes. (3) The superior zone corresponds to the remainder of the rectal mucous membrane, and contains a rich network whose collecting vessels pass to the anorectal glands, and thence along the superior hemorrhoidal artery to the mesocolic and inferior mesenteric nodes (Morris).

The above description will serve to give the reader a rather definite notion of the

lymphatic drainage of the rectum and anus, but sight must not be lost of the fact that many of the lymphatic channels from especially the middle portion of the rectum join directly with the internal iliac lymph glands and with the sacral glands. From these nodes the lymph passes to the common iliac and aortic (lumbar) lymph glands.

SUMMARY

We may state that the lymphatic ducts of the appendix, cecum, ascending colon, right colic flexure, and right two-thirds of the transverse colon follow in general the distribution of the superior mesenteric artery and end in the superior mesenteric lymph nodes, whence the lymph passes through the gastrointestinal (common intestinal) trunk to the cisterna chyli. Lymph from at least a portion of the left flexure of the colon passes to the superior mesenteric lymph glands and to the lymph glands of the hilum of the spleen. The lymph drainage of the descending colon, pelvic colon, and most of the rectum is through the inferior mesenteric and iliac glands and thence to the left lumbar glands. Lymph from the lower part of the anal canal passes by way of vessels which terminate in the superficial inguinal lymph nodes.

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THE MANAGEMENT OF A PERMANENT COLOSTOMY*

LEONARD JAMES DRUCKERMAN, M.D.

Adjunct Surgeon, Mt. Sinai Hospital

NEW YORK CITY

PATIENTS who have permanent colostomies vary widely in their way of life depending upon their personalities and upon the system of colostomy management employed. Many of these patients have found that the pattern of their lives have been changed only in small detail. These people have resumed their occupations, engaged in every business and profession, and have found their colostomies a relatively minor handicap. Often their deformity has been unknown not only to their casual acquaintances but even to their business associates and friends. These patients have in large measure enjoyed almost complete economic and social rehabilitation.

This encouraging picture is not, however, descriptive of all colostomy patients, for there are many others who lead narrow, secluded lives, lives which center and revolve about the colostomy and its difficulties. These people are constantly fearful of an unexpected movement which will embarrass and inconvenience them and betray their misfortune to all about them. Some few may rightfully attribute their unfortunate state to the location of the colostomies in the right side of the colon, where the stool is liquid and where control by any means is extremely difficult and undependable. However most permanent colostomies are today located in the left side of the colon where the stool is relatively solid and where adequate control may by proper procedures be readily established, thus freeing the patient from constant apprehension and anxiety, and permitting him to be restored to a useful and comparatively comfortable existence.

Widely differing methods of colostomy control have been used by physicians. The commonest method is the use of one of the many different types of colostomy bags. Some physicians employ absorbent dressings which are changed as often as necessary. Occasionally, patients are advised to purge themselves drastically one day, and take advantage of the resultant period of constipation. Many and varied pressure devices have been employed in an attempt to control the colostomy by external pressure, and not a few gadgets have been used to "cork up" the colostomy for variable periods. Some physicians have emphasized the importance of diet, medication, formation of a regular bowel habit, and of irrigations in the proper regulation of a colostomy.

At the Mt. Sinai Hospital a régime for the care of colostomy patients has been established. It has proved eminently successful in coping with the difficulties presented by abdominal artificial ani. This routine is based largely on the fact that most of our permanent colostomies are left sided, so that the patients can be made to have formed stool in their colons. This routine will be described under six headings:

1. Diet
2. Medication
3. Irrigation and training
4. Use of appliances and dressings
5. Care of the skin
6. General measures.

1. DIET

The object of the diet is to render the patient so very constipated that evacuation will occur only upon irrigation. The diet should result in a stool which is hard, dry, formed and scant in amounts. The

* From the Surgical Service of Dr. Ralph Colp, Mt. Sinai Hospital, New York City.

diet which is most successful in accomplishing this is a bland, low residue diet with low fat and high carbohydrate components.

A bland diet must be non-stimulating and non-irritating. Condiments, strong alcoholic drinks, iced drinks and charged water are not permitted and any food which may have a laxative action such as prunes or apricots should be avoided. No foods which produce bulk in the stool should be taken. The vegetables and fruits which are allowed should be well cooked to render them as soft as possible, and initially, these should be puréed. It is often expedient to use the strained vegetables and fruits which are sold in jars for use in infant feeding. Indigestible foods, which tend to pass through the intestinal tract unchanged, such as berries and the tendinous parts of meat, should never be eaten.

The low fat diet has been found to be most constipating. Cattell[1,2] starts his patients with a bland low fat diet and later increases the amount of fats. Hesse[3] believes that a high fat diet increases intestinal action and also limits fats. Schmieden[4] employs a low fat diet until satisfactory function is obtained. DuBois[5,6] suggests that at first all foods containing considerable fat be avoided. Some difficulty may be encountered in giving meals with sufficiently high caloric value so that patients may regain weight lost during operative procedures and convalescence. However, the judicious use of chocolate, cocoa, and jellies and drinks sweetened with sugar, will increase caloric intake so that a satisfactory gain in weight may occur if other factors are conducive to this.

We do not limit the fluid intake although certain authors[3,4] do this. Rarely limitation of fluid may be necessary. It is certainly true, however, that a smaller food intake results in a smaller amount of stool, and for this reason, DuBois recommends abstemiousness. This too is rarely necessary but may be attempted in obstinate cases which do not respond favorably to the usual methods of control.

Meals should be taken at regular hours, eaten slowly, and no food should be permitted between meals. The patient who nibbles at food throughout the day is often the one who frequently has small movements in the dressings. Whenever practical, water should be taken only at meal time as otherwise it may serve to incite the gastrocolic reflex and result in movement of stool or passage of gas.

THE INITIAL COLOSTOMY DIET

The Following Foods Are Recommended:

Vegetables—Cooked vegetables with soft cellulose (potatoes, carrots, squash).
Vegetable purée (peas, beets, string beans, tomatoes, asparagus tips).

Fruits—Cooked fruits with skins and seeds removed (apple, pear, peach).
Strained juices (orange, grapefruit, pineapple, tomato).

Breads and Cereal—White bread and plain crackers.
Cooked fine cereals and gruels (rice, cream of wheat, patent barley).
Dry ready to serve cereals without bran (corn flakes, puffed wheat).
Spaghetti, noodles, macaroni.
Plain cake.

Dairy Products—All milk must be boiled.
Unfermented cheese, especially cottage cheese.
Small amounts of butter.
Eggs—boiled or poached.

Meats—Tender, well cooked meat, fish and chicken. Fat and tendinous parts should be avoided.

Desserts—Cake or fruit as above.
Clear fruit jelly.
Simple, bland desserts (cornstarch, chocolate or junket, tapioca pudding, custard, plain gelatin).

Miscellaneous—Creamed sauces, cocoa, chocolate, weak tea, caffeine-free coffee.

The Following Foods Should Be Avoided:

Vegetables—All vegetables except those listed above.
Any raw vegetable.

Irritating vegetables (onions, peppers, radishes).
Vegetables high in residue.
Vegetables which tend to cause gas (beans).
Fruits—Raw fruits.
Fruits high in indigestible cellulose (pineapple).
Fruits containing many seeds (berries).
Breads and Cereals—Whole grain breads (wholewheat and pumpernickel).
Cereals high in residue (bran cereals).
Dairy Products—Cream.
Fermented cheese.
Meat—Pork, veal or duck.
Skins of poultry.
Fatty and fibrous parts of meat.
Miscellaneous—Fried foods of any kind.
Jams.
Spices and condiments, highly seasoned or strongly salted foods.
Coffee, strong tea, charged water, alcoholic beverages.

A suggested diet follows:

Breakfast

Fruit juice or fruit as described
Well cooked cereal with boiled milk and sugar
Eggs
White bread or toast with butter or jelly
Caffeine-free coffee, or chocolate or cocoa

Lunch

Milk soup with strained vegetables or clear soup
Meat or cheese or eggs
Vegetables as listed
Custard or pudding or gelatin
White bread with butter or jelly
Cocoa or tea

Dinner

Tomato juice
Soup as above
Meat, fish or chicken
Boiled, baked or mashed potato
Puréed vegetables as listed
Cooked fruit or pudding
White bread with butter or jelly
Cocoa or tea

Shortly after the desired degree of constipation is obtained, other foods may be added. Only one new food should be added during one two-day period so that if a food produces loose movements it can readily be recognized. Patients vary greatly in the degree of irritability of their digestive tracts. Some will be constipated regardless of the food eaten and others will have a profuse diarrhea following the eating of a raw apple. In this regard, patients may be arbitrarily divided into three groups. The first group is comprised of patients who have been constipated all their lives and who remain so after operation. These patients may, after a time, eat anything without ill effect on the function of the artificial anus. The second and largest group is composed of those whose frequency of normal movement directly reflects the foods eaten. Here, obviously, proper diet will be quite important in attaining a marked degree of constipation. The third group includes individuals who normally have two or three bowel movements daily. These patients are moderately difficult to control and require meticulous dietetic management, augmented by proper medication in order to achieve successful colostomy control.

It behooves the physician, therefore, to classify the patient and to add foods with these facts in mind. The first usual addition is to allow the whole cooked vegetable instead of the purée. Subsequently, raw fruits with the skins and seeds removed, and a greater variety of vegetables are added. Uncooked milk is substituted for boiled milk and the fat content of the diet is increased by allowing more butter, cream and the fatty parts of meat. Fried foods are added last, if at all. The usual coffee is taken instead of caffeine-free coffee. Cooked sea foods are attempted quite late in the period of regulation. Foods such as cabbage, celery, poultry skins and others which have an irritating or bulky residue may only be permitted to those who classify as group one. Additions are made slowly until the patient is receiving the

greatest variety of foods that is compatible with a marked degree of constipation. The ultimate diet will naturally vary, depending on whether the patient is in group one, two or three.

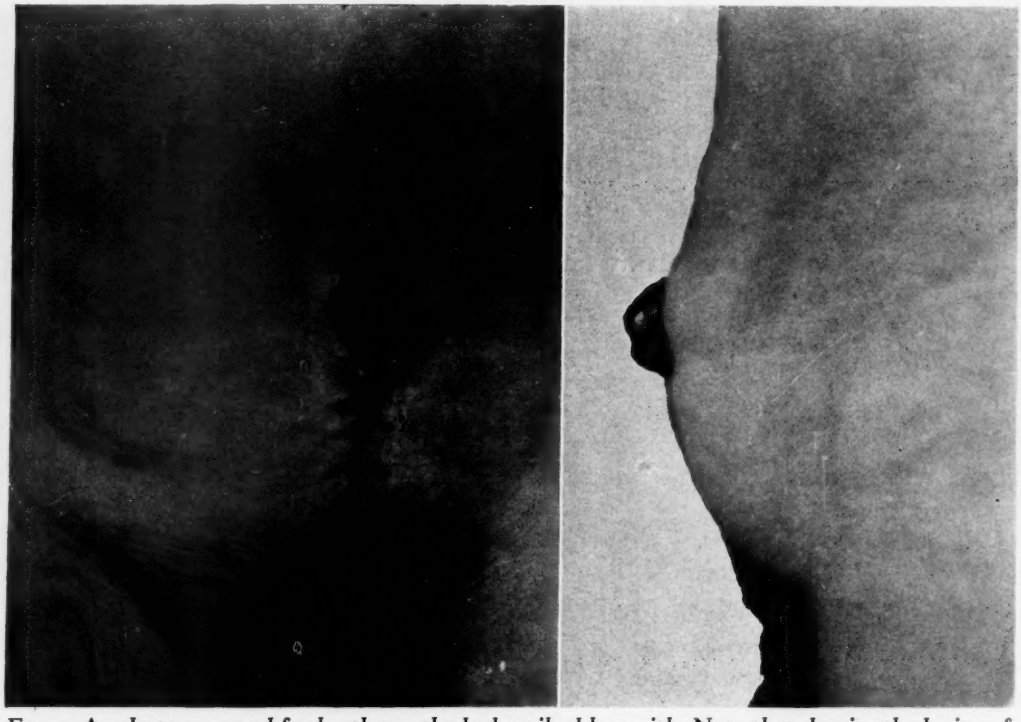

FIG. 1. A colostomy cared for by the methods described herewith. Note that despite the laxity of the abdomen and the presence of a contiguous large incision, there is no herniation about the stoma.

2. MEDICATION

Although the majority of colostomy patients do not need constipating medications, there are, however, certain patients who require them and are greatly benefited by their use. The patient with a transverse colostomy who despite careful attention to diet still has loose stools, may be greatly helped by the proper medicines. The nervous, high-strung individual often requires constipating medication and small doses of sedatives for successful regulation. The judicious use of drugs is indicated when patients are first attempting to constipate themselves. Finally, they may be temporarily necessary after a dietary indiscretion.

Bismuth subcarbonate is one of the most useful drugs. In doses of 15 to 60 gr., three times a day, it induces constipation and allays diarrhea. DuBois states that it tends to deodorize the stool. It occasionally diminishes the amount of gas. Powdered kaolin, a somewhat less constipating medication, may occasionally be used along with, or instead of bismuth.

Opium is very often efficacious when other drugs fail, but it should be used over relatively short periods of time. It may be administered simultaneously with other medications. The two frequently used preparations are tincture of opium in doses of 5, 10, or 20 minims, three or four times daily, and paregoric in teaspoonful doses at like intervals. The amount of morphine administered is relatively small, the former containing $\frac{1}{10}$ of a grain of morphine in each 10 minims, and the latter containing $\frac{1}{40}$ of a grain of morphine to each 4 c.c.

Charcoal is a time honored remedy for excessive amounts of gas. Sollmann[7] claims that whereas freshly heated charcoal adsorbs gasses, moist charcoal does not

possess this quality and that it is, therefore, unsuccessful in the treatment of flatulence. Schmieden reports that it not only rids the patient of gas but also deodorizes the stools. Hesse speaks highly of animal charcoal for similar reasons. We have found that finely divided and dried vegetable charcoal occasionally reduces the amount of gas. It is administered in doses of 15 to 30 gr. three times a day.

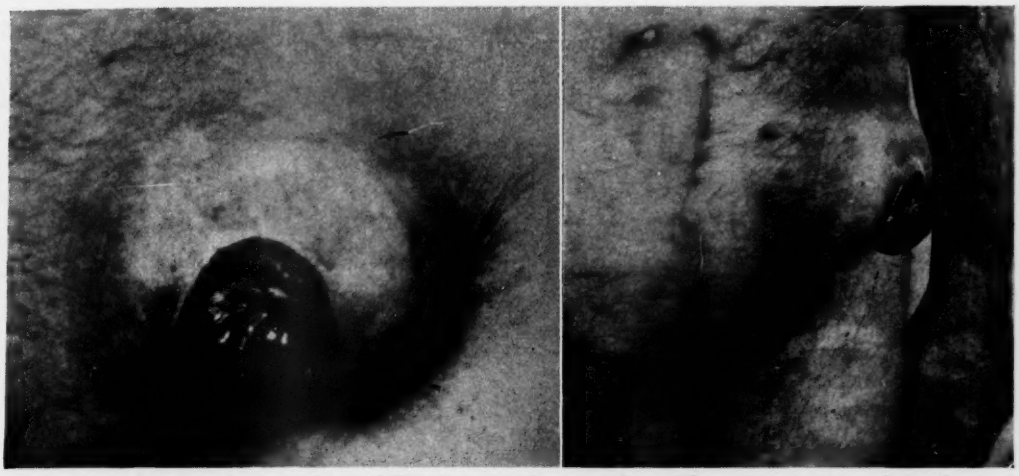

Fig. 2. A colostomy in a patient addicted to a colostomy bag. The colostomy was brought out through a small incision which was completely filled by the exteriorized colon. Note the hernia about the colostomy and the absence of hernia in the long rectus incision. The hernia conforms exactly in size to cup of the colostomy bag. The pressure marks of the cup may be seen. These peristomal herniae are caused by ischemia of the underlying muscles and fascia due to pressure of the cup, by the suction effect of the bag or by both. This hernia has since grown even larger.

The use of kerol, a patent medicine, to deodorize the excreta is recommended by Lockhart-Mummery,[8] Shedden,[9] and Best.[10] A capsule containing 3 minims is given daily before breakfast.

There are some who believe in controlling an artificial anus by having a so-called "stool day," every third day, by means of vigorous catharsis. Following this diarrhea, the patient remains constipated for a day or two. This method is mentioned only to be vehemently condemned. Laxatives and purgatives are but rarely needed and are not necessary in the proper management of a colostomy. Even such a mild lubricant as mineral oil should not be used. Constipation is the state we attempt to produce so that dejection of feces will occur every two or three days and then only under the stimulus of an irrigation. No one who has spent several hours with a colostomy patient suffering from diarrhea will need to be cautioned against the use of purgatives.

Occasionally one sees left-sided colostomy patients who do not respond to the constipating diet and medications. These patients may be suspected of having so-called gastrogenous diarrhea due to achylia gastrica. Diagnosis is made, of course, by a fractional test meal. Rehfuss[11] states that even small amounts of hydrochloric acid will succeed in overcoming this diarrhea. The dilute hydrochloric acid may be used in liquid, capsule, or tablet form and is generally taken with meals. When it is employed in properly selected cases its effects are striking. A patient on a constipating régime who is having many loose movements will within one day after starting the acid medication, become markedly constipated.

It is recommended that those patients who require a strict constipating diet over long periods of time be given concentrated vitamins, especially D and B, to augment the scant vitamin content of the diet.

3. IRRIGATION AND TRAINING

Irrigations are of primary importance in colostomy management. In the literature

one finds scattered reports about a chronic colitis that occurs following long continued use of irrigations. This is not, however, the usual experience, for most observers see no ill effects from their long continued use. Binkley[12] has employed daily irrigations in colostomies for many years and has found this a most satisfactory method. Cattell, Smith[13] Bowman,[14] and others, employ irrigations routinely. We have had excellent results from the irrigation treatment and so far have never seen ill effects.

The object of the irrigation is to empty the colon thoroughly of its fecal content so that no movement will occur in the intervals between irrigations. The length of these intervals must be determined by trial and error. Patients who were chronically constipated prior to operation will often be able to allow two or three days between irrigations. This may also be true for those who are able to achieve a marked degree of constipation by means of diet and medication. Constipation in patients with an artificial anus has not been found to be detrimental to the general health. The average patient requires an irrigation about once in twenty-four hours.

The simplest possible technique is employed. An ordinary enema bag or can is equipped with a tube, a shut-off valve, a glass adapter and a 26 F. catheter. Warm tap water is used for the irrigation which may be given with the patient sitting, standing, or lying in bed. The enema can is placed about 3 feet above the level of the artificial anus, the catheter is inserted into the colostomy as far as it will go, and the water is allowed to flow in slowly. A large deep basin is held snugly against the abdomen just below the colostomy to catch whatever may run back along the catheter. Sometimes it is necessary to hold a piece of gauze or cotton tightly against the lumen of the bowel to prevent too much loss of water. When the patient feels quite full, the catheter is removed and the water and intestinal contents are expelled into the basin. When all the water and stool have seemingly been expelled, the entire procedure is repeated once or several times until the return is clear. About ten to twenty minutes are allowed to elapse before the permanent dressing is applied because during this time fluid temporarily retained in the colon will be discharged. A small piece of gauze and a large thick cellucotton or cotton pad is placed over the stoma to absorb the fluid as it is expelled. Later the permanent dressing is applied. Further attention is usually not required for the ensuing twenty-four hours or longer periods, depending upon the patient.

This is the so-called "open" method of irrigation which we have found to be the best for routine use. With a little care and practice it can be performed with no soiling of the body, clothes, or room. The average time required is about forty-five minutes. The only parts of the apparatus requiring cleaning are the catheter and the basin. There is, however, a "closed" method of irrigation for which numerous devices have been invented. Best[15] employs a metal urinal which has a tube running into it near the handle and out through the mouth of the urinal. This tube is inserted into the artificial anus, the urinal is held firmly against the abdomen over the stoma, and the water is allowed to flow through the tube, wash out the colon and run back into the urinal. Binkley uses an excellent apparatus for closed irrigations. It consists of a bakelite cup which has a small opening for a catheter and a wide outlet which connects with a broad soft rubber tube. The cup is held in position over the stoma by an adjustable canvas belt. The apparatus can be used with the patient lying in bed or sitting on the toilet. The irrigating fluid is run into the colon through the catheter and the returning fluid and feces are expelled into the cup and conveyed through the wide rubber tube into a receptacle or into the toilet unseen by the patient. Binkley has found this method so satisfactory that he uses it routinely.

For the fastidious or sensitive patient, one or another of these appliances may be found very useful. The advantage of the

closed method lies solely in its esthetic appeal. Its disadvantages are: the apparatus itself must be cleaned, the irrigation takes longer, and the continuous irrigation with the catheter in place does not clean the bowel quite as well as the intermittent flushing and emptying.

There is a small percentage of patients who do not need to employ irrigations but are able to have a regular movement every morning and remain perfectly clean for the remainder of the day. Many more patients are able to have the regular movement but tend to have several very small movements during the day. Gibson[16] prefers irrigation to training for this reason. Lockhart-Mummery attempts to train his patients to have regular movements before inaugurating irrigation treatment. Schmieden and Hesse advocate training. Webb[17] employs small irrigations at first for the purpose of establishing habitual morning evacuations. The individual who is fortunate enough to have this automatic function is to be encouraged provided that he is able to remain perfectly clean for a full day between movements. The method of starting this movement varies with the individual. Some find that the thought of a movement is sufficient to initiate it; others find that a glass of cold water or hot coffee, or a cigarette may cause the bowel to function. In our experience very few patients are able to remain perfectly clean for twenty-four hours without irrigations.

4. USE OF APPLIANCES AND DRESSINGS

Colostomy bags are but rarely prescribed. They are never employed for left sided colostomies but are used exclusively in the unusual permanent cecostomy or transverse colostomy when these cannot be controlled by the ordinary methods, because of the liquid stool present in the right side of the colon. The colostomy bag is an unsatisfactory appliance, which is difficult to clean and to keep clean. It distorts the patient's figure. It is usually made partly of rubber and after a week or two of use produces a musty, offensive odor. It usually is expensive and requires frequent renewal. Irritation of the skin and stoma is a common finding among those who persist in using these bags.

Binkley, Gabriel and Lloyd-Davies,[18] Best, Landsman,[19] and others call attention to the frequent abdominal wall weaknesses and ventral herniae seen about the stoma among those who are addicted to colostomy bags. These are probably caused by ischemia from the pressure of the rim of the bag, or by the suction effect of the bag. The protrusion of bowel all too frequently seen in these cases is due to the suction effect and presumably the more frequent movements are likewise attributable to the same cause. There is no doubt that prolapse and ventral hernia occur among those who do not wear colostomy bags, but the incidence is very much less. Furthermore, we have seen patients develop both hernia and prolapse months after discharge from the hospital after they were fitted with a colostomy bag by their physicians. Prior to this they had repeatedly been examined in the follow-up clinic and found to have neither hernia nor prolapse. It is also true that a low grade inflammation of the exteriorized mucous membrane is often seen in patients wearing colostomy bags. The thick mucus that is discharged constantly from these colostomies is very distressing and quite frequently produces a dermatitis of the surrounding skin. One needs only to watch the offensive, messy spectacle of a patient changing and cleaning the bag in order to be thoroughly disgusted with it. A colostomy bag should be used as a last resort when all else fails, and should almost never be needed for the proper control of a left-sided colostomy.

For the few unfortunates who require a colostomy bag, it is advisable to secure one possessing several important qualities. It should be, if possible, inexpensive, so that a new one may be frequently obtained. The cup fitting over the stoma should have a small diameter so as to lessen the tendency to produce herniae. The straps should be detachable and washable and the contrivance should be relatively flat in order

that it may not cause too great a bulge and distortion of the patient's normal contour.

Patients often find that gauze or cellucotton, inserted into the colostomy bag at each cleaning, tends to absorb the fluid, and so make the wearer more comfortable, the need for change less frequent, and the cleaning of the bag easier.

It is a mistake to send the patient to a surgical supply house and allow the patient to be fitted according to the whims of the salesman or the stock of the organization. Whenever possible, the physician himself should select the bag.

Ordinarily no appliance is needed and the simplest dressing is employed. After the temporary dressing previously described is removed, it is replaced by the permanent dressing. The exposed bowel is covered with a strip of gauze on which boric acid ointment or vaseline has been applied. Another piece of gauze is placed over this and a pad of cotton or cellucotton is then applied. Some patients have strips of adhesive on either side of the abdomen; to these strips are tied pieces of tape, and these are tied across the dressing. The majority of patients merely wear their supporting belts over the dressing with a piece of oiled silk interposed between the belt and the dressing. Most patients wear a belt and all are encouraged to do so. A simple belt made of elastic webbing is quite satisfactory, inexpensive, and may be made by the patient. They have some tendency to roll at the sides and are at times productive of postprandial pressure and discomfort. An adjustable abdominal support made of knitted elastic, narrow over the sides and back, and broad in front, with two or three pliable vertical supports anteriorly, has been found most satisfactory. Some patients have in addition a simple elastic belt or muslin binder which is used at night.

5. CARE OF THE SKIN

It is surprising to find how well the skin about an artificial anus will appear, if the anus is cared for in the manner described. Occasionally, however, especially in cases in which a colostomy has been made in the right half of the colon, a certain amount of chronic and acute dermatitis may occur.

In the prevention and treatment of dermatitis, any ointment which adequately protects the skin from the irritant to which it has been subjected may be used. The ointment we have found to be most efficacious is made of 10 per cent zinc oxide and 10 per cent finely powdered aluminum in anhydrous lanolin. This is applied on the thoroughly cleaned and dried skin all about the stoma, and the usual dressings applied. It is of great importance that the patient keep watching for the first sign of dermatitis because when it is moderately advanced, it is quite difficult to cure. An ointment should be used constantly if the stoma discharges irritating stool, liquid stool or much mucus.

Occasionally excessive granulations form at the junction between the skin and the mucous membrane. These not infrequently bleed slightly, causing blood spots on the dressings which are viewed by the patient with great consternation. One or two applications of strong silver nitrate to this area will result in prompt disappearance of the granulations and in the cessation of the bleeding. Rarely, the rough introduction of the irrigation tube has caused bleeding, but no cases of perforation or any serious consequences have come to our attention.

Stenosis of the opening of the artificial anus is not harmful provided that sufficient opening exists so that stool can easily emerge. Moderate stenosis is successfully treated by simple dilatation with the finger or with bougies, preferably after the infiltration of novocain in the surrounding skin. If, however, the stenosis is accompanied by progressive retraction of the exposed bowel into the abdomen, corrective surgical procedures are indicated.

6. GENERAL MEASURES

All patients are given instructions in the proper methods of self irrigation and colostomy care before they are discharged from the hospital. This includes the performance by the patient of all manipula-

tions under guidance. They are also given printed directions for the proper method of open irrigation, a list of foods to be eaten, a list of foods to be avoided, and a typical diet. Those who may require it are visited at home by a nurse who further instructs the patient and some member of the family in the proper methods of colostomy care, and elucidates any points not completely understood by the patient.

Initially, the patients are seen by the physician at frequent intervals, and alterations in the régime, including dietary additions, are prescribed if indicated. Subsequently, after adequate regulation is attained and the greatest dietary freedom commensurate with marked constipation realized, the patients are seen only at intervals of four to six months. The weight is observed, and a search is made for distant metastases. The colostomy is carefully examined for local recurrence, stenosis, retraction of the spur, prolapse and hernia. With a finger deep in the colostomy, local recurrences, glands involved by metastases, or peritoneal implants may be palpated long before their presence will be discernible in any other fashion.

Most patients learn by trial and error just how much exercise they may safely do. Very unusually patients report small movements after moderately severe exertion; the obvious treatment is curtailment of the more violent types of exercise. As a general rule, however, very little stress need be placed on restriction of activity.

Individualization is a *sine qua non* in the management of a colostomy. It is only to be expected that great variation will be found in the response of patients to the initiation and continuation of life with a colostomy. Whereas most patients will accept the colostomy with fortitude, if not stoically, and will coöperate with willingness, others may threaten suicide, refuse any form of self care, and require trained attendants for months after operation. It is obvious that methods employed successfully with the first type of patient will be insufficient with the second type of patient. The latter will require frequent long talks to break down the resistance to self care and to promote acceptance of colostomy life. Finer variations in response are treated according to the best judgment of the physician and his knowledge of their psychology. Each patient must be considered as an individual and as an individual problem, and the routine varied accordingly. Infinite tact, patience, and finesse are required in caring for these patients to whom the colostomy comes as a loathsome disfigurement and as an unnatural, hideous deformity. Yet it is possible, by proper schooling and guidance of thought and action, to restore these people to such an excellent state of almost normal existence that the attending physician himself may be amazed, and most certainly, pleased.

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DIVERTICULOSIS OF THE COLON

IRVIN ABELL, M.D.

Clinical Professor of Surgery, University of Louisville School of Medicine

LOUISVILLE, KENTUCKY

DIVERTICULA are noted at all points in the intestinal tract from the pharyngo-esophageal junction to and including the rectum. While accurate anatomic descriptions, chiefly from post-mortem studies, were given by various authors—notably Virchow, Graser, and Fischer—during the latter part of the last century, the appreciation of their surgical significance came with the beginning of the present century, the attention of the profession being directed by the papers of Beer, W. J. Mayo, Moynihan, Drummond, Lockhart-Mummery, and others.

In the last twenty-five years the literature upon the subject has become quite voluminous, based upon clinical and pathologic studies of a sufficiently large number of cases to warrant accurate interpretation of pathology, diagnosis, and treatment. The fact that in their symptomatology diverticula offer a counterpart of other diseases common to the intestinal tract at the points at which they occur lends an added interest to their study. They occur as sacculations projecting from varying portions of the circumference of the intestinal tube—mesenteric, antemesenteric and lateral—and range in number from one to several hundred. Hausman reported one instance in which 400 were found. While occurring in all portions of the intestinal tract, they reach their greatest profusion in the colon, particularly in its left half. Diverticula have been described as congenital or true, and acquired or false, the former containing all the coats of the intestinal tube, the latter representing protrusions or herniations of the mucous and submucous coats through apertures in the muscularis. The term diverticulosis connotes the presence of such sacculations while diverticulitis implies the varying changes which occur as the result of irritation and inflammation.

Autopsy records would indicate their occurrence in 5 per cent of all subjects over 40 years of age. While the vast majority are seen at and after middle life, they have been reported at much earlier ages, A. P. C. Ashhurst reporting a sigmoid diverticulitis in a child of 7 years and 9 months and Erdmann one in a child under 7 years of age. Only twenty in 1,819 patients at the Mayo Clinic showing diverticulosis of the colon were under 40 years of age. Diverticula of the sigmoid are by far the most common, the descending colon also being frequently involved. It is estimated that on an average 85 per cent are found in these two portions of the colon. The rectum, transverse and ascending colon share in the distribution of the remaining 15 per cent, with infrequent similar findings in the appendix. Our series shows twelve patients presenting diverticulosis of the appendix, in one of whom a diverticulitis with perforation had occurred.

Stout reports an incidence of 1.89 per cent of diverticulosis of the appendix in the cases of appendicitis operated on at the Presbyterian Hospital, New York, in one year. The diverticula occur between layers of the mesoappendix, projecting from the appendix like buds, and are frequently multiple. In addition to the danger of diverticulitis and perforation, simple diverticula afford an added risk, since in the process of cutting through the mesoappendix close to the appendix they may be opened, with resultant contamination of the operative field. While diverticula of the colon may be single, they are as a rule multiple, varying in number within rather wide limits. Practically all of those ob-

served in the colon are of the false or acquired type, the sac consisting of mucosa and submucosa covered with peritoneum.

The fact that they are of the acquired type and occur late in life has not prevented the assumption by some that the fundamental cause is an inherent weakness of the intestinal musculature which has existed since birth, in other words that they are essentially congenital in origin. Since they are of the pulsion type, it is logical to assume that muscular weakness, whether congenital or acquired, is the fundamental factor and increased intracolonic pressure the exciting cause in their production. It has been argued that they occur as the result of the weakening of the intestinal musculature by the piercing of the muscles by the vessels of the bowel wall: their appearance at points other than these corresponding to the entry and exit of vessels would clearly indicate that other factors play a part.

Regardless of the cause—upon which there is no unanimity of opinion—once the diverticulum is formed it becomes a bottle-shaped process, with a narrow mouth and wide body, into which the fecal current enters with the eventual formation of fecaliths. There is consequent inflammatory change secondary to the obstruction and stagnation. There are no symptoms referable to simple diverticulosis. The number of such patients that ultimately develop diverticulitis and present subjective symptoms is conjectural, but has been estimated at from 10 to 20 per cent. The symptoms are caused by inflammatory changes in the sac and surrounding structures, notably in the mesentery, dependent upon inadequate drainage of the sac. The fecal current in the right half of the colon is largely liquid while that in the left half tends to become more and more solid. As a result diverticula in the left half more frequently show the presence of fecaliths which obstruct drainage and predispose to the development of inflammatory changes. They are always potential and often actual foci of acute or chronic infection and merit attention not as rarities but as abnormalities which may remain innocuous or give rise to symptoms of varying grades of severity and to pathologic changes which may prove amenable to treatment or end in disaster.

The symptoms necessarily depend upon the character and extent of the changes present. With acute inflammation in a single diverticulum they closely resemble those of appendicitis—pain, nausea, and vomiting, localized tenderness and rigidity, and increased leucocyte count. If the diverticulum happens to be situated in the cecum or ascending colon differential diagnosis will be impossible until the abdomen is opened; and because of the mimicry of appendicitis such cases are almost routinely subjected to operation. When the lesion is in the left half of the colon a preoperative diagnosis can be more readily made.

Granting the presence of a diverticulitis one of several results may follow, namely, resolution; perforation with resultant diffuse peritonitis; abscess; perforation into a surrounding viscus (bladder or intestine); ischiorectal abscess; and thickening of the gut wall, mesocolic, and surrounding fat so that obstruction of varying degrees results.

Opinion is divided as to the wisest course to pursue in the presence of an acute diverticulitis. Most surgeons prefer to pursue an expectant plan of treatment until complications arise which necessitate surgical intervention, i.e., perforation or abscess; while others advocate immediate operation, consisting of excision of the diverticulum with closure of the opening in the intestine or simple drainage as local conditions warrant. Since diverticula are so frequently multiple, the removal of one that presents acute inflammation affords no immunity to the remaining ones against similar changes, and moreover since the acute inflammatory process frequently comes to a spontaneous end it would seem the part of wisdom to treat them expectantly until the advent of complications that demand surgical intervention.

Perforation into the peritoneal cavity produces a diffuse suppurative peritonitis not distinguishable from that produced by other infectious lesions and demands similar treatment. The peridiverticulitis, almost uniformly noted, makes this complication a rare one. Both in free perforations and in those resulting in localized abscess formation attempts at repair of these are successful, while the remainder, like those treated with drainage alone, result in fistulae. The latter are usually of small caliber and frequently heal spontaneously. When they persist, secondary closure or resection can be done later, after subsidence of the acute reaction lessens the hazard.

The subjective symptoms noted in chronic diverticulitis consist of periodical attacks of digestive disturbance with abdominal discomfort and uneasiness and at times definite pain which is usually referred to the site of the infected diverticula. Localized soreness and tenderness can usually be elicited in the region of the diverticulitis and not infrequently a mass can be felt. Roentgenologic study constitutes the most important aid in diagnosis, not only locating the site of the lesion but determining as well the extent of the involvement.

Many of the chronic cases prove self-limiting, presenting occasional periods of more or less activity with long intervals of quiescence. Such instances require no treatment other than supervision of diet with prevention of constipation. The oral administration of one of the petroleum preparations and the rectal use of oil or other soothing enemata will be of help. If spasticity is revealed by the *x*-ray the addition of belladonna or stramonium to the above regimen will frequently suffice to relieve it.

The complications induced by chronic diverticulitis which demand surgical relief are fistulae and obstruction. The fistulae may communicate with the skin, adjacent intestine or bladder. The diagnosis of the former is self-evident; the entero-intestinal type will usually be revealed only at operation, while the enterovesical variety is evidenced by vesical irritability with the passage of feces and gas per urethram. The latter are easily demonstrated by cystoscopic examination. Operative correction of such fistulae may in some cases prove relatively easy, in others it entails difficult and hazardous procedures. The excision of the tract with closure of the opening in the bowel is the ideal. In our experience, this can, as just stated, be readily done in some instances, in others resection of the thickened, distorted bowel will be required. The enterovesical fistulae, if situated high up on both the bladder and sigmoid, are accessible to manipulation and correction; if, however, the opening is located low down in both organs, the difficulty of access combined with the inflammatory infiltration make its correction both difficult and hazardous. In such cases we have elected to do a permanent colostomy with satisfying results.

Obstruction may occur in acute diverticulitis as a result of infection and edema particularly when there is involvement of an appreciable segment of the sigmoid: the localization of the pain, the acute sensitiveness of the frequently palpable mass, the elevation of temperature and the accompanying leucocytosis will all point to inflammatory rather than neoplastic origin but will not exclude perforating carcinoma which may produce an identical clinical picture. The previous clinical history will in most instances afford a differentiation, while in the occasional case further observation will be required for a distinction between them. When the obstruction is incomplete it not infrequently subsides under expectant treatment, when further study can be safely made. When complete, the obstruction at once assumes a position of urgency; an enterostomy proximal to the lesion is indicated for relief. This procedure often permits resolution of the diverticulitis to such an extent that no further surgery is needed: when such a fortuitous outcome does not obtain, or

should the obstructive lesion prove malignant, subsequent resection can be more safely carried out.

Chronic obstruction is due to hyperplasia, adhesions and angulation, the so called hyperplastic, stenosing type. Especial interest attaches to this type of diverticulitis since it may closely simulate carcinoma or be impossible to differentiate, its successful treatment demanding as much judgment and skill. The symptoms include varying degrees of discomfort, flatulence, pain referred to the lower left abdomen, constipation, obstipation and obstruction. Since the lesion often involves a longer segment of the bowel than does carcinoma, a mass is more likely to be palpable, usually sensitive to the touch. The barium enema shows a lesion which narrows the lumen, often more extensive than carcinoma but at times not distinguishable from it: the presence of one or more diverticula in the neighborhood are suggestive but not pathognomonic since carcinoma is as likely to affect the colon in the 5 per cent of individuals who have diverticulosis as in an equal number of those in whom such is absent. A sawtooth serration of the barium shadow, due to compression of the mucosal folds, is quite characteristic when present. Digital palpation of the rectum has only an exclusion value and the proctoscope shows only thickening and edema.

Resection, where general conditions do not contraindicate its employment, is the treatment of choice. As with colonic resections for other lesions, experience has shown the two-stage operation to be the safer procedure. Drainage of the bowel proximal to the obstruction allows recession of the inflammatory phenomena at the site of the diverticulitis and the upbuilding of the patient's vitality, both of which enhance the safety of the second stage. Both the suture and Mikulicz type of resection have proved satisfactory, the choice being determined by the experience and preference of the surgeon. The Mikulicz procedure is more applicable here than in carcinoma since the tendency to less radical resections is of smaller moment and there can be no grafting of the disease into the wound. The presence of blood in the stool is noted in a small percentage of patients with the obstructive type of diverticulitis. That it is not more frequently present is due to the fact that the disease is not an ulcerative one, the pathologic changes being largely extramucosal and found in the wall of the bowel, the mesocolic and surrounding fat. Jones quotes Spriggs as stating that bleeding occurred three times in sixty-eight cases of diverticulitis, or 5 per cent, and Rankin as stating that it occurred thirty-three times in 227 cases, or 17 per cent. The presence of blood in the stool which can be demonstrated with the proctoscope to come from above the lower rectum has so great a diagnostic value for carcinoma of the colon as to make the differential diagnosis between carcinoma and diverticulitis at times extremely difficult when this symptom is present. The *x*-ray may show one or more diverticula and the lesion causing the bleeding still be carcinoma. The history, the duration of symptoms, the character of defect as revealed by the *x*-ray are all of value in reaching a decision.

A study of the recent literature indicates the incidence of carcinoma developing on diverticulitis at from 1.7 to 8 per cent. This incidence, together with the difficulty in distinguishing between carcinoma and diverticulitis in the presence of a palpable mass or defect revealed by the *x*-ray, and associated with bleeding from above the lower rectum, makes early exploration a far safer procedure in all such cases than medical regimens which involve delay.

THE TREATMENT AND PROGNOSIS OF DIVERTICULITIS OF THE COLON

PHILIP W. BROWN, M.D.

Division of Medicine, The Mayo Clinic

ROCHESTER, MINNESOTA

DIVERTICULA may extrude from the wall of any hollow viscus. Some diverticula, such as Meckel's diverticula, which occur in 1 to 2 per cent of all persons, are developmental anomalies, while others, such as traction diverticula of the esophagus, may be associated with an inflammatory process of neighboring structures. In most cases there is no obvious explanation for the presence of the diverticula that are encountered in the gastrointestinal tract or in the urinary bladder. Obviously, increased inward pressure and weakness of a portion of the visceral wall are physical reasons but the "why" is not understood.

At The Mayo Clinic, the incidence of diverticula of the colon is 6 per cent in cases in which the patients are observed clinically and 5 per cent in cases in which necropsy is performed. Spriggs and Marxer found diverticula of the colon in 10 per cent of 1,000 consecutive cases in which roentgenologic examination of the gastrointestinal tract was performed. This is probably a maximal figure. In contrast, Kocour said that diverticula were found in 127, or 1.9 per cent, of 7,000 consecutive cases in which necropsy was performed.

The age, and to a lesser extent, the sex of patients who have diverticula of the colon have always been of interest. Aside from a few rare instances of apparently true congenital diverticula of the colon, the condition is uncommon under the age of 40 years and rare under the age of 30 years. I do not know if race is a factor; relatively few negroes and even fewer Asiatics are examined at the clinic. In this particular study, only one negro, who was a female, was encountered.

Table 1 shows the age and sex of the patients in 596 of approximately 1,100 cases of diverticulosis and diverticulitis which were observed at the clinic in the decade January 1, 1919 to December 31, 1928, inclusive. The ratio of men to women in the 596 cases was 1.6:1. In all cases observed at the clinic the ratio of males to females is 1.04:1. In ninety-nine of the 596 cases operation was performed for diverticulitis. Table II shows the age and sex of

TABLE I

AGE AND SEX OF PATIENTS IN 596 CASES OF DIVERTICULOSIS AND DIVERTICULITIS OF THE COLON

Sex*	Age					
	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 84
Men (367, or 61 per cent)	..	18	63	146	109	31
Women (229, or 39 per cent)	1	8	41	100	69	10
Total (596 cases)	1	26	104	246	178	41

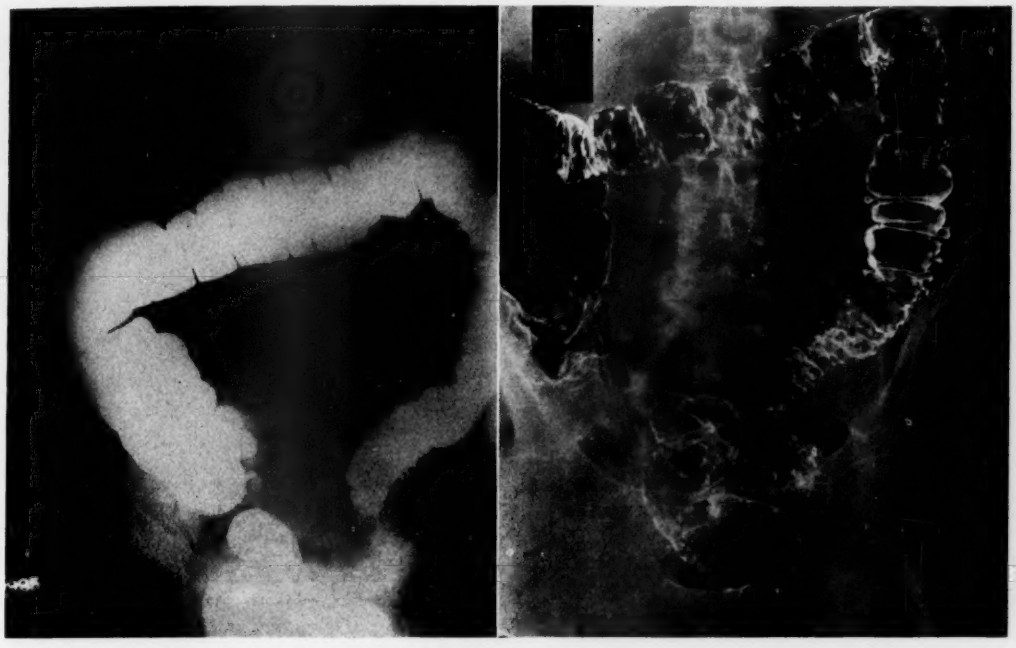
* The ratio of men to women was 1.6:1.

TABLE II

AGE AND SEX OF PATIENTS OPERATED ON FOR DIVERTICULITIS OF THE COLON (1919–1938 INCLUSIVE)

Sex	Age					
	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 80
Men (122, or 63 per cent)	1	7	34	43	33	4
Women (69, or 37 per cent)	..	2	19	24	22	2
Total (191)	1	9	53	67	55	6

the patients in 191 cases of diverticulitis in which operation was performed in the two decades January 1, 1919 to December 1938, inclusive. Ninety-nine of the 191 cases also are included in Table I. In the 191 cases in Table II, the ratio of men to women was 1.8:1.



A B

Fig. 1. A, diverticula of colon and diverticulitis of the sigmoid as demonstrated with the usual technique. B, air technique visualizes much more clearly the numerous diverticula as well as the diverticulitis in the sigmoid.

According to Dixon, Deuterman, and Weber, the site of diverticula of the intestine is as follows: duodenum in 18 per cent, jejunum in 6 per cent, ileum in 1.5 per cent, cecum and ascending colon in 4.5 per cent, transverse colon in 3 per cent, descending colon in 4.5 per cent, sigmoid in 59.5 per cent and rectum in 3 per cent of cases, respectively. If one considers only diverticula of the colon, the sigmoid is involved in 75 to 80 per cent of cases. The involvement may be limited to the sigmoid or diverticula may be present in other segments of the colon. Diverticula of the colon and an area of diverticulitis of the sigmoid are nicely demonstrated in Figure 1. Especially striking is the depiction of the diverticula after evacuation of the barium and inflation with air.

Spriggs and Marxer described what they believed was a prediverticular stage. Lockhart-Mummery reported that the diverticula increased in number and size in cases in which the patients were observed for years.

I continue to be perplexed by the fact that diverticulitis develops in only a small proportion of patients who have diverticula of the colon. As Marcley and I noted, diverticulitis was present in 376 of more than 1,100 cases of diverticulosis. This suggests that diverticulitis apparently occurs in a third of the cases of diverticulosis but this is true only for this group of cases. A careful record is not made of all diverticula that are found on roentgenologic examination nor do all patients who are 40 or more years of age undergo this examination. It is probable that many people who are 40 or more years of age have minor attacks of abdominal pain which are never sufficient to warrant medical care but which may be due to mild diverticulitis. However, the number who experience sufficient trouble to seek medical advice is

not likely to be more than 10 per cent of the total number who have these peculiar little pouches in the colon.

Fig. 2. Diverticulitis of sigmoid with extravasation of opaque material from perforation. Abscess of psoas muscle developed later by extension of the infection.

Likewise there is another puzzling question: why do complications which require surgical treatment develop in some cases of diverticulitis but not in others? This question is as unanswerable as it is in cases of duodenal ulcer. The ratio of patients who require surgical or medical treatment for diverticulitis is purely dependent on the cases studied; therefore, one cannot predict that a certain percentage of patients with diverticulitis will eventually require surgical treatment. This would seem to be proved by my previous report which showed that of 277 patients who had diverticulitis, only four are known to have undergone operation after they left the clinic.

The first report of the surgical treatment of diverticulitis was made by Mayo, Wilson and Giffin, in 1907. Their teaching has done much to establish our knowledge of the surgical treatment of this disease. In many cases the disease is acute from the onset and operation has to be undertaken without delay. It is interesting to note the duration of symptoms in the ninety-two cases in

Fig. 3. Complete obstruction of colon at junction of sigmoid and descending colon; successful resection of involved segment.

which operation was performed in the decade 1929 to 1938 inclusive. In this decade the diagnostic acumen should have improved and all possible measures were undertaken in an effort to avoid operation. In seventeen of the ninety-two cases symptoms had been present for one month or less when operation was performed. In thirty-seven cases symptoms had been present for one month to one year before operation was performed at the clinic. In six of the thirty-seven cases an operation had been performed before the patients came to the clinic. The operations that had been performed in these cases were as follows: drainage of an abscess, colostomy and exploratory laparotomy. A diagnosis of carcinoma had been made in some of these cases. Medical treatment had proved unsuccessful in at least eight of the fifty-four cases in which symptoms had been present for a year or less before operation and there is no doubt that medical treatment had been employed in other cases in this group. It is especially interesting to note that in these fifty-four cases the

progress of the disease was so rapid that operation could not be delayed.

Medical treatment was especially disappointing in the twenty-seven cases in which symptoms had been present for one to five years before operation was performed at the clinic. In nine of the twenty-seven cases, operation had been performed before the patients came to the clinic and thorough medical treatment had been employed in at least four of the nine cases. In four of the ninety-two cases symptoms had been present for six to ten years and in seven cases symptoms had been present for more than ten years before operation was performed. Therefore, in thirty-eight cases the patients had had symptoms from one to more than ten years. This is an indication of the failure of medical treatment. Although ten of the thirty-eight patients had undergone some type of operation which had failed to cure the condition, the implication of prior medical failure still holds. There is no question that there has been, and should be, a determined effort to avoid operation but it is futile and even dangerous to continue medical treatment after complications have developed. I have the same impression that I expressed previously, namely, that in some cases of diverticulitis the symptoms are severe almost from the onset and operation eventually will be required.

TABLE III

RESULTS OBTAINED WITH VARIOUS SURGICAL PROCEDURES IN 191 CASES OF DIVERTICULITIS OF THE COLON

Surgical Procedures	Results						
	Cases	Alive and Well	Died after Operation	Died of Related Condition	Died of Unrelated Condition	Not Well	No Data
Preliminary colostomy; subsequent resection of colon and closure of colonic stoma	27	14	7	1	1	3	1
One-stage resection of colon	8	5*	1	.....	1	1*	
Obstructive type of resection of colon and subsequent closure of colonic stoma	20	11*	4	.....	1	.....	4
Colostomy only	36	9	3	5	8	9	2
Mikulicz type of resection of colon	31	19†	3	3	5	1	
Colostomy and subsequent closure of colonic stoma	22	10	.....	1	3	8	
Closure of perforation	10	3	.....	2	4	1	
Drainage of abscess	12	5	.....	.....	2	4	1
Emergency cecostomy	6	3	2	.....	1		
Exploratory laparotomy	13	4	1	.....	1	5	2
Miscellaneous procedures	6	1	1	1	.....	2	1
Total	191	84 (43.9%)	22 (11.5%)	13 (6.8%)	27 (14.1%)	34 (17.8%)	11 (5.7%)

* Colostomy in one case.
† Four patients have a sinus.

The most serious complications are perforation with abscess formation (Fig. 2) around the bowel, and extensive tumefaction with obstruction (Fig. 3) and perforation of the disease process into an adherent loop of bowel, into the bladder or through the abdominal wall. Occasionally one encounters a patient who is seriously ill, with high fever, leucocytosis and an abdominal or pelvic mass, and operation seems inevitable. Finally there is a sudden dis-

charge of pus from the rectum as the abscess fortunately ruptures and drains into the bowel. Recovery may ensue without operation. When a patient passes cloudy urine and gas is expelled from the urethra at the end of micturition, one can be practically certain that the patient has a vesicosigmoidal fistula, and the most common cause of spontaneous vesicosigmoidal fistula is diverticulitis of the sigmoid. In a few cases, fecaluria has occurred so insidiously that operation has been performed for a vesical condition and the true cause has been established only at the time of operation.

Another source of diagnostic error occurs more often among women than among men. There may be vague, indefinite symptoms of lower abdominal and pelvic distress and a mass may be felt on bimanual examination. Because of the mass, operation is undertaken and sigmoidal diverticulitis is encountered. Roentgenologic examination of the colon in the hands of an expert rarely leads to error but such examination occasionally discloses a filling defect that is not readily distinguishable from the defect caused by cancer. Very properly the surgeon cannot delay operation if cancer is suspected.

The immediate and late results of some of the surgical procedures are listed in Table III. Resection of the diseased segment, if possible, is the most radical but the most certain method of effecting a cure. Colostomy alone is required in some cases, usually in those cases in which a large mass and often in cases in which a fistula remains at the site of the drainage of an abscess. This is a lifesaving but not a curative procedure; however, patients can and do remain in fair health without any further operation. Colostomy, followed in some months by closure of the colonic stoma, is not a very satisfactory operation. However, if a vesicosigmoidal fistula is not present there is about an equal chance that no further operation will be needed. In twenty-two cases a colostomy was performed and the colonic stoma was closed later. In thirteen of the twenty-two cases the patients were apparently well or died of unrelated causes, but in nine cases the disease persisted.

TABLE IV
RESULTS OF SURGICAL TREATMENT IN 191 CASES OF DIVERTICULITIS

Results	Years since Operation				
	0 to 5	5 to 10	10 to 15	15 to 20	Total
Patients cured	34	25	21	4	84
Symptoms persist	21	6	6	1	34
Related deaths	33	2	..	..	35
Deaths from unrelated or unknown causes	16	7	4	..	27
No data	..	..	..	..	11

Table IV shows the results of surgical treatment. Many factors enter into the evaluation of results but the chief one is the fact that many patients are in the sixth and seventh decades of life. If the eighty-four cases in which the patients were living and well at the time the data were obtained and the twenty-seven cases in which the patients died of unknown or unrelated causes are included, it will be found that in 101, or 56 per cent, of the 180 cases in which follow-up data were obtained the patients were benefited by the operation. Even in many of the thirty-four cases in which symptoms persist, the patients are not invalids and would have died had they not been treated surgically. That sixty-one patients lived at least five or more years after the operation indicates that all is not sorrow and tribulation in dealing with this serious disease. One may seem optimistic in saying that a patient who has a persistent fecal fistula or a colonic stoma is well but the patients themselves do not consider either of these a serious handicap; they are glad to be alive and to be able to carry on their usual duties.

In cases in which the onset of the disease is acute, the treatment is most difficult as

one has to decide whether operation should be performed at once. Fortunately such cases are few. Probably the next most serious type of diverticulitis is that associated with a vesicosigmoidal fistula. A hole between the colon and bladder is a serious condition because ultimate infection of the entire urinary tract is almost certain to occur. Probably one of the earliest descriptions of this complication was that by Freund, in 1730. Gouverneur, Soupault and Latifi found such fistulas in thirty-eight, or 11 per cent, of 324 cases of diverticulitis of the sigmoid. Higgins reported 328 cases of vesicosigmoidal fistula and found that in 160 of the cases the fistula was the result of an inflammatory condition; in ninety-two of the 160 cases the patients had diverticulitis. Lockhart-Mummery encountered a fistula in twelve of ninety-one cases of diverticulitis in which he operated.

A vesicosigmoidal fistula was present in thirty, or 15 per cent, of the 191 cases in this series. There were seven postoperative deaths and later in the succeeding months four more patients died of a continuation of the infection. Nineteen patients survived the operation for months to years; twelve of the nineteen were apparently well but seven had more or less persistence of the disease.

In twelve of the cases of vesicosigmoidal fistula in which the patients were cured, a resection of the diseased segment of the colon was performed; in four cases, remarkable to learn, the fistulous tract was simply closed; and in one case a colostomy resulted in closure of the fistula but the colonic stoma has remained open.

It is unusual to encounter fistulas of the bladder complicating diverticulitis in cases in which the patients are females. The anatomy of the female pelvis naturally explains this, but in three of the thirty cases in which this complication occurred the patients were women.

There is an important economic factor in cases in which operation is required. Not infrequently the better part of a year is spent in the hospital, especially in the cases in which multiple operative stages are required. The patient may be in the hospital from fifty to more than 100 days and intervals of weeks and even months may elapse between the various stages of the operative procedure. Although it does seem that complications will develop in some cases in spite of medical treatment, the long period required for the operative treatment, the 18 per cent mortality (immediate and later) and the 18 per cent of patients who continue to have trouble should spur one to do everything possible to control diverticulitis by medical means.

What medical measures are of value? As with inflammation elsewhere in the body, rest and heat are the chief weapons. The patient who has an acute attack of diverticulitis should be kept in bed, and really kept there, for two to three weeks. It is a frequent error to allow the patient to be up before the process has subsided. The temperature and the leucocyte count may be normal and the patient assures the physician that he "feels fine." That is good news, but tenderness remains over the region involved and roentgenologic study will show persistence of spasm and irritability. Until the inflammation has fully subsided, the patient should be kept in bed.

One of the best methods of directing heat to the involved region is by means of short wave diathermy. Application of heat for thirty to forty minutes, twice daily, to the involved region often serves to effect rapid resolution of a tumefaction. Application of heat by means of the Elliott method is very helpful, especially if the patient is a woman. The rectal attachment may be used if the patient is a man but this often is not well tolerated. Simple electric pads or hot water bottles afford some heat but the penetration and resultant vasodilatation are less pronounced than they are when diathermy is used. Hot rectal irrigations of physiologic saline solution administered by means of two way irrigating tubes, and the use of hot douches are other methods of obtaining heat. Abdominal stupes, if kept hot and if they are not too heavy, likewise afford

some relief; their usefulness is somewhat increased from the angle of "doing something"; it is not psychotherapy but partly so.

What about diet? At the onset of an acute attack, the less taken by mouth, the more the bowel can rest. Ordinarily, water, fruit juices and tea or coffee are permissible but if much obstruction is present, parenterally administered fluids for one or two days may be of great value. As the acute phase subsides, nonresidue foods, such as eggs, rice, arrowroot cookies, butter, broth and gelatine puddings, should be added. Gradually, a normal menu should be resumed. By normal is meant avoidance of foreign and undigestible material. Reports from many patients have stated that "if I avoid nuts, popcorn, bran and berries with big seeds, I have little or no trouble." In only rare instances has it been found necessary for the patient to eat only purées of vegetables and strained fruits. A few patients have found that they are better if they limit the amount of raw fruits and vegetables in their diet, although this is true of many people who have a sensitive intestine but no demonstrable disease of the bowel.

What drugs, laxatives and enemas are to be prescribed? There are no drugs of any curative value, as far as one can judge by clinical observation. Administration of tincture of belladonna, even to the point of physiologic tolerance, is of doubtful value. From time to time new preparations are offered that are said to be "real antispasmodics," but the clinical results have not been encouraging.

Laxatives are sometimes needed, especially in cases in which the patients are elderly individuals who have had more or less constipation for years. In the large majority of cases the administration of 4 to 16 c.c. of liquid petrolatum once or twice daily is all that is needed. A frequently repeated comment by the patient is: "By avoiding the coarse, undigestible foods and taking a daily swallow of the oil, I get along easily." Although some patients object to liquid petrolatum because of its tendency to leak through the anal sphincter, I urge them to take a "small swallow" once a day. I have no proof that it minimizes accumulation of detritus in the diverticula but advise its use because it causes many patients to feel better. At present there is some objection to the use of liquid petrolatum. The proctologists hold that it seems to delay healing following anorectal operations and that it interferes with the dilatation of the anal sphincter by the normally formed stool. This objection would not apply to patients with diverticulitis. Another criticism is that the oil prevents absorption of vitamin A; if the oil is taken only on arising or on retiring, this possibility is minimized. In the patients who are thin the age old remedy, olive oil, administered orally in daily doses of 30 to 60 c.c., may be all that is needed to obtain a daily bowel movement. Obesity and intolerance prevent its use in the majority of cases.

If more than oil is needed to obtain a daily bowel movement, I suggest 10 to 40 minims (0.6 to 2.6 c.c.) of fluidextract of cascara in water after each meal. There is no serious objection to any laxative but one should stress the wisdom of using as little as is necessary. Nor is there any great objection to an occasional warm enema although it is not wise to take one every day. Enemas should be used only when the bowels have not been moving very well and if there is a sense of uneasiness in the abdomen.

If there are "signs and rumblings" of an attack, the patient should be urged to limit his activities, eat only the lighter types of food, and perhaps spend a day or so in bed, apply heat to the abdominal wall and use hot rectal irrigations.

That this regimen is efficient is borne out by a former report which showed that 63 per cent of the patients treated medically were well and that approximately three-fourths of the remaining 37 per cent were able to carry on with relatively little difficulty.

This same general program, simple as it is, is applied in either the group of cases in which obstructive symptoms predominate or in those cases in which the inflammatory symptoms (one-third) are outstanding. It is important to recall that in most of the cases in which a vesicosigmoidal fistula develops the symptoms are chiefly the result of inflammation; hence, the need for all possible care even though the more dramatic symptoms of obstruction are not present.

This encouraging aspect of the medical management naturally raises a doubt in the surgeon's mind as he points out that medical treatment has failed in most of his cases. He properly comments on the patients who have progressively severe symptoms for one or many years, until the complications compel them to seek his aid. The surgeon sees the worst side of diverticulitis and the cases of severe diverticulitis which he observes in a year make a profound impression on him.

To pass to the other extreme, is it not peculiar that when diverticula are accidentally discovered in the course of an examination, only rarely do any of them cause trouble? Is there any need to prescribe treatment in cases in which diverticulosis is discovered? Is it well not to tell the patient about the pouches for fear that he will ascribe symptoms of them? Since diverticulosis is not a disease but merely a peculiar condition, no treatment per se is indicated. Yet we know that some patients do have severe diverticulitis and hence it is sensible to minimize the chance of serious trouble and advise patients in whom diverticula are found to avoid nuts, bran, coarse seeds, and to take a daily dose of liquid petrolatum.

It is usually advisable to tell the patient that the pouches have been discovered but that they are unrelated to his present complaints, and to explain briefly to the patient what they are and what occasionally ensues, and to advise him to follow the dietary suggestions which have been given. This will forestall a possible incorrect implication of trouble owing to diverticulosis if discovered by some unscrupulous person and will protect the conscientious physician from "losing face" in the opinion of his patient.

CONCLUSIONS

1. Diverticulosis of the colon is present in about 5 per cent of people who are 40 or more years of age.

2. It is not possible to predict the number of cases of diverticulosis in which diverticulitis will sooner or later develop.

3. Likewise unpredictable is the number of cases of diverticulitis in which operation eventually will be required.

4. In approximately a sixth of cases in which operation is required, symptoms develop rapidly and operation must be performed within a month or less after the first sign of the disease. In fully half of the cases in which surgical treatment is employed operation has to be performed within the first year of the disease. In the remaining cases the patients carry along from bad to worse for one to several years before operation is undertaken.

5. A vesicosigmoidal fistula had developed in thirty, or 15 per cent, of 191 cases of diverticulitis in which surgical treatment was employed. Three of the patients were women.

6. In 56 per cent of the 191 cases the patients were well; not all of them were perfectly normal but they were well able to carry on a satisfactory life.

7. Diverticulosis is a relatively innocuous condition; in cases of diverticulitis in which the disease can be cared for with medical treatment the outlook is favorable while in cases in which surgical treatment is required the condition is serious.

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Adherence to the principle of non-closure of anal wounds, together with the existence of an apparent immunity of the area to serious infection, are the two important factors which safeguard surgery of the anus and rectum.

MALIGNANT DISEASE OF THE COLON*

FACTORS INFLUENCING THE OPERABILITY, MORBIDITY AND MORTALITY

ARTHUR W. ALLEN, M.D., F.A.C.S. AND CLAUDE E. WELCH, M.D.

Chief, East Surgical Service, Massachusetts General Hospital

Assistant in Surgery, Massachusetts General Hospital

BOSTON, MASSACHUSETTS

THROUGH a gradual improvement in diagnostic methods, physiologic principles, anesthesia and surgical technique, there has come about a marked increase in the number of cured patients who have sought relief from carcinoma of the bowel. Educational programs have been helpful to the physician in calling his attention to early symptoms and signs of the disease. This cancer education has been beneficial to the layman as well, since he is much more apt to have his abdominal discomfort, change in bowel habit, weight loss, fatigability or rectal bleeding thoroughly investigated.

Although many patients still come or are referred with hopelessly advanced lesions, it is fair to say that in many instances the onset of symptoms has been so insidious and without disability that one finds it difficult to place the blame. On the other hand, we see a large percentage of these patients who could have had a cure if they or their physicians had been more alert to the proper interpretation of their earlier warnings. It is encouraging, however, to find the operability and curability of these disorders gradually but surely increasing during the past few years. This is not statistically evident in our group from a percentage standpoint so much as from a marked increase in the number of such patients seeking relief. Not that this means an acute increase in the incidence of the disease so much as that the possibility of cure has been demonstrated.

Many such patients were given no hope of cure by their physicians in earlier years due to the high mortality and morbidity associated with radical operative procedures. More often the true nature of their ailment remained unrecognized until obstruction or peritonitis from a perforation of the growth made them acutely ill. Now we find an increasing tendency to an earlier diagnosis and with this will come a far greater number of cures.

Progress in the management of malignant disease of the colon has been limited almost entirely to surgery. Radiation, thus far, has proved less effective in this type of cancer than in many other varieties. Development of adequate care has come about in large centers where these cases concentrate. Excellent surgeons in smaller communities meet the situation fairly by referring these less common and more complicated problems to larger hospitals. By improvements in the attack, brought about as the result of experience, many of the less effective methods of handling such lesions have been abandoned.

Extirpation of the segment of bowel containing the growth alone is not sufficient. The lymph node area draining this field must be included in the resection. The patient must be evaluated on the basis of his general condition, the extent and location of his disease, and after careful preparation, operated upon in a logical sequence of events. The ultimate aim is elimination of his cancer and a comfortable existence after his convalescence. It has finally become recognized that a permanent colostomy is compatible with health and happiness. Fortunately, this mental hazard

* From the Surgical Department of the Massachusetts General Hospital.

is rarely necessary in the treatment of cancer of the colon above the rectosigmoid junction.

The causes of immediate failure in this group of cases are now limited to peritonitis, pneumonia and unpreventable complications, such as coronary occlusion, pulmonary embolus, cerebral hemorrhage, etc. (Table 1.) The first of these may be reduced to a minimum by carefully staged procedures and aseptic surgery. The incidence of pulmonary complications can be lowered by better preparation and aftercare, and by a correct choice of anesthesia and procedure. Deaths may occur from too extensive resections but often one successfully extirpates portions of secondarily involved structures.

TABLE 1
CAUSES OF DEATH IN CARCINOMA OF COLON—RADICAL RESECTIONS (1925–1938)

	Cecum	Transverse	Descending	Sigmoid	Total
Peritonitis	10	6	4	21	41
Pneumonia	6	4	1	6	17
Pulmonary embolus	3	2	0	2	7
Intestinal obstruction	1	1	1	2	5
Cardiac failure	0	0	0	3	3
Carcinoma, metastatic	0	0	1	0	1
Pyelitis	0	0	0	2	2
Shock	2	0	0	0	2
Cerebral accident	0	0	0	3	3
Mesenteric thrombosis	0	1	0	0	1
Empyema	1	0	0	0	1
Undetermined	1	1	1	0	3
Total	24	15	8	39	86

The definition of operability is difficult and unless the error is made on the radical side at times many resectable and curable lesions will be left alone or temporized with by proximal drainage or short circuit.

One must realize that cancer of the colon is a remediable disease. The earlier the diagnosis is made, the better the prognosis. The operation must be carefully planned and undertaken by those sufficiently familiar with the various problems likely to arise. A surgeon loses nothing by acknowledging his limitations. His patients and his confrères respect him more if he bows to greater experience in a situation he meets so rarely that he has been unable to attain competence.

The U. S. Public Health statistics for 1936 state that 15,364 people died that year of cancer of the bowel exclusive of the rectum.[1] This represents about 11 per cent of all the deaths from cancer for that year. Inasmuch as the colon can be safely and adequately resected segmentally or as a whole and since the disease is always curable in its early stage, we should constantly have it in mind. In the years from 1925 to 1938 inclusive, there were 634 patients with cancer of the colon admitted to the Massachusetts General Hospital. Of these, 365, or 58 per cent, were resectable. This operability can be increased only by earlier diagnosis and the abandonment of the idea that some physicians hold that the disease is incurable or that their patient cannot stand the operation. Many patients are denied help until they are obstructed or moribund from perforation or hopeless extension of the disease.

The insidious onset of cancer makes it imperative to take notice of any sign or symptom known to be associated with it. These warnings are often manifested so early in cancer of the colon that it seems reasonable to hope that in the future more of the patients suffering from this disease will appeal for help in a curable state. It is discouraging, however, to find in a yearly analysis of the cases admitted to our clinic over the thirteen year period included in this study that the number of months of delay between first symptoms and admission to the hospital has remained the same; that is, approximately eight months. One could work out on a larger group of cases the influence of delay on curability very accurately. We know from the data we have at hand and from reports accumulated by others that the importance of reducing

the interval between diagnosis and operation cannot be over-emphasized.

In the group considered here, we find a distribution in the colon best illustrated by Figure 1. We have divided the bowel into four arbitrary segments since the procedure of choice may differ considerably in these various locations. In the total 634 cases we found involvement of the cecum and ascending colon in 162 instances or 25.5 per cent, the transverse colon in seventy or 11 per cent, the splenic flexure and descending colon in sixty-one or 9.6 per cent, and the sigmoid in 341 or 53.9 per cent. Thus, those areas where stasis occurs are most often involved and the lower colon is the more likely site.

There were four patients in this group under 30 years of age and six over 80, the youngest being 23 and the oldest 91. The peak is in the fifth decade with 32 per cent. The third decade accounts for 4.6 per cent, the fourth for 18.5 per cent, the sixth 29.5 per cent, the seventh 12.6 per cent and the eighth only 1.1 per cent. Males were 56.5 per cent of the total.

In this same interval of time, 818 patients with carcinoma of the rectum were admitted to the hospital. These will not be considered further in this discussion other than to say that these figures give a distorted view of the comparative frequency of the disease. The 1936 statistics given by the U. S. Public Health Report indicates that carcinoma occurs at least twice as often in the colon as in the rectum. Doubtless fewer surgeons in our community are willing to undertake radical extirpation of the rectum than are ready to operate upon the lesions of the colon.

In considering the various locations of cancer of the colon and the operative procedures giving the most satisfactory outcome, it is only fair to say that each surgeon must adopt the method that gives him the best result. In a careful analysis of our cases operated upon by a number of surgeons, it was obvious that no given set of rules can apply to all men dealing with this problem. One surgeon may have no mortality from an open anastomosis while another almost invariably will produce a fatal peritonitis. Another may, by his meticulous technique, have no trouble from local infection but by his prolonged procedure have a high death rate from pneumonia. Aseptic resection in the hands of some men is unsatisfactory due to their inability to adhere strictly to the other important principles of intelligent intestinal surgery. Exteriorization has been used in a small percentage of our cases, usually in the very poor risk patient, and has been attended by a high mortality rate.

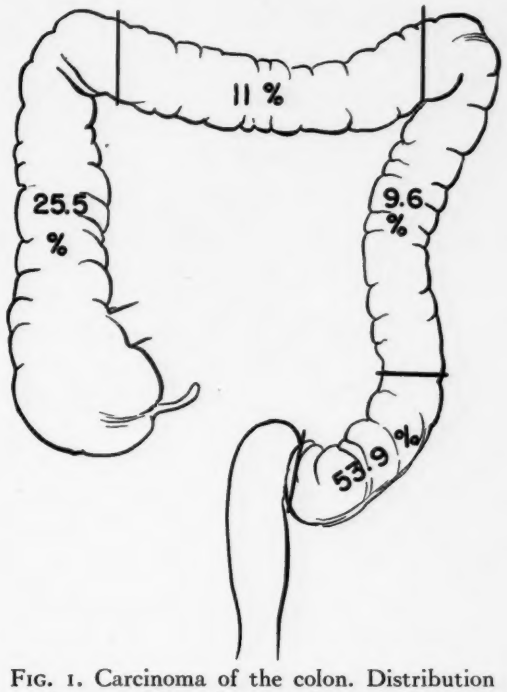

Fig. 1. Carcinoma of the colon. Distribution of cases, Massachusetts General Hospital, 1925–1938.

It is obvious that one must avoid gross contamination of the peritoneal cavity. The diseased area must be removed and, in most instances, continuity of the bowel reëstablished. The blood supply to the anastomosed ends must be preserved. Sutures must approximate the serous coats of the bowel and the mucous membrane must be inverted. There must be no tension on the suture line and no drains resting near it. Traps in the mesentery must be closed and raw surfaces peritonealized

when possible. Proximal complimentary decompression must be established if not provided by a previous procedure. If one need has passed.[2] (Fig. 2.) In cancer of the right colon, we do a preliminary ileotransverse colostomy. (Fig. 3.) In a few large, badly infected, obstructive growths, a complete proximal defunctioning colostomy is done as a preliminary operation to resection. (Fig. 4.) The type of temporary colostomy suggested by Devine[3] is a logical procedure; we have carried it out in a few instances and expect to use it more often in the future. We wish to call attention to the feasibility of utilizing the splenic flexure through a subcostal or transverse incision for the Devine colostomy when possible. The permanent scarring with resulting adhesions in the right upper quadrant and mid-abdomen makes it undesirable in many younger individuals who may well need surgery on the stomach or biliary tract in later years.

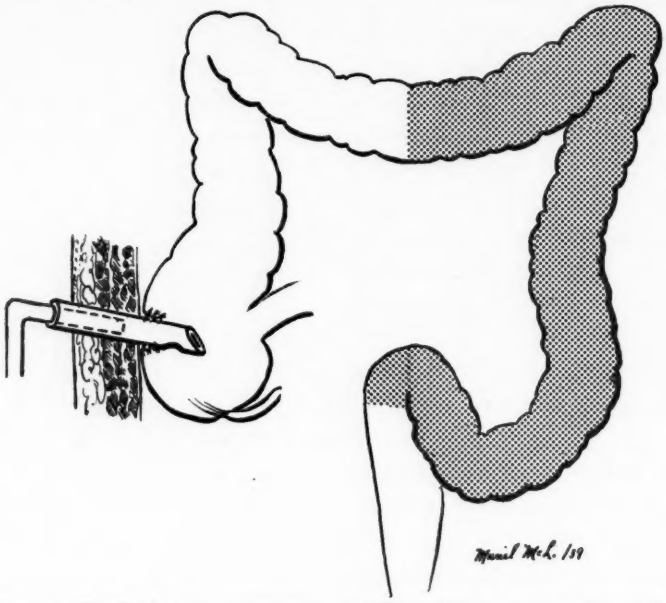

FIG. 2. Preliminary cecostomy. Indicated for tumor located anywhere in the left half of the bowel.

can add to these rules good general surgical principles, the results will be satisfactory.

In our own hands, we have found that two-stage procedures have lowered our mortality. For the left colon, this means a preliminary cecostomy of the type that will function satisfactorily for a period of three weeks and close spontaneously after its

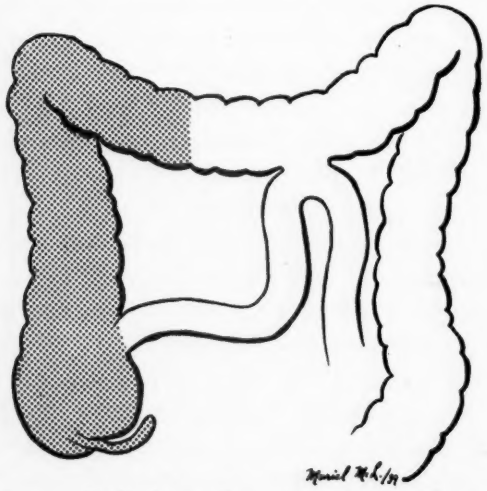

FIG. 3. Preliminary ileotransverse colostomy. Indicated if the tumor is located in the right half of the colon.

We believe preliminary proximal operations should be done routinely for malignant lesions of the large bowel whether the patient appears to be obstructed or not, and regardless of the age or condition of the patient. Too many "good risk" patients have succumbed to one-stage operations upon the bowel. We are sure that rarely, if ever, has a well planned two-stage opera-

tion added to the risk of life or interfered with adequate extirpation of the disease. It makes the task a bit harder for the for the poorer risks. When we consider that the divided operation materially reduces the incidence of the two most prevalent

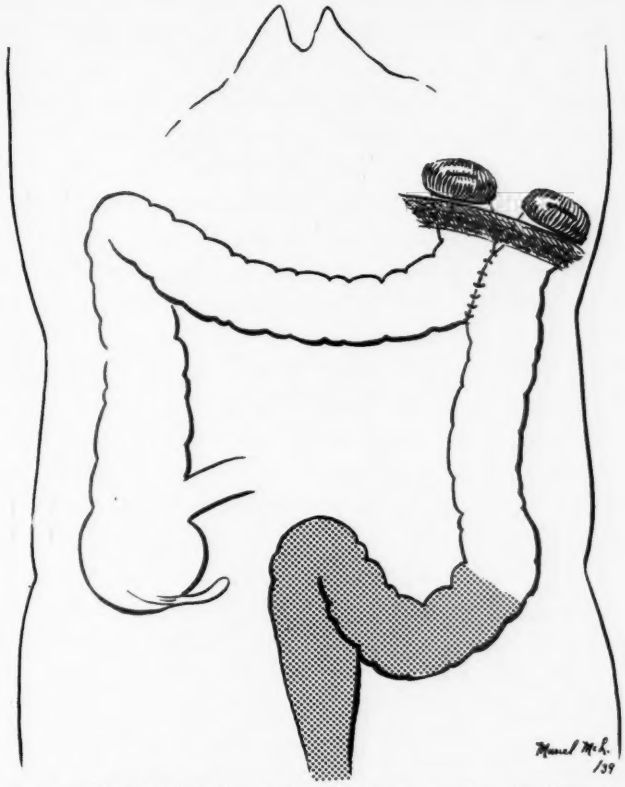

Fig. 4. Modified Devine defunctioning operation. Indicated if lesion is in the sigmoid or rectum, and is large, obstructing, or perforating.

surgeon, and the patient naturally dislikes a second trip to the operating room. Neither of these arguments is sound since both have to do with convenience rather than the chief objective.

We have recorded the facts that the hospital stay of the patient operated upon in two stages for cancer of the colon is increased on an average of ten days but that the fatal complications of peritonitis and pneumonia are materially reduced.[4] In this same report which included carcinoma of the rectum, we found that in 400 one-stage operations there was a mortality rate of 19.2 per cent while in 253 two-stage procedures, the death rate was 13 per cent. These figures were impressive to us since during the years covered by this report, our surgeons were definitely one-stage minded and chose the two-stage procedures fatal complications in spite of the so-called "double opportunity," there seems little to support the one-stage enthusiast. That creditable results may be obtained by single stage operations in well selected cases by experienced abdominal surgeons we admit, but we are sure that these same men would attain a truly enviable mortality rate if they took advantage of the added safety of the divided attack.

Our personal experience during the period of this study is based on 107 cases of carcinoma of the colon in the regions requiring abdominal approaches only. We were able to extirpate the involved area in all but seven patients, an operability of 93.6 per cent. This high figure means that radical resection was done if the tumor mass could be moved and had not invaded structures necessary to life by direct

extension. By this attitude, the mortality rate was increased but there were many long comfortable respites from recurrence of disease that justified the procedures. Doubtless, our high operability was influenced by the fact that most of these patients were from the private wards, implying, on the whole, an earlier lesion than that found in patients admitted to the general hospital wards. There were ten deaths in thirty-one one-stage operations and five deaths in sixty-nine two-stage procedures. The value of the divided attack is most strikingly illustrated in cancer of the right colon with twenty-two consecutive resections without a fatality.

The next most important factor in the reduction of mortality in this group appears to be the method of handling the sectioned bowel. Since the sigmoid lesions were more prevalent in our series and offer sufficient data for statistical purposes, we will report in some detail the results of various operative procedures in this area. (Table II.) We

TABLE II
RADICAL RESECTION FOR CARCINOMA OF SIGMOID ACCORDING TO TYPE OF ANASTOMOSIS (M.G.H. 1925–1938)

	Total	Deaths	Per Cent
Parker-Kerr anastomosis	52	6	11
Open anastomosis	38	9	23
"Turn-out" operations	41	12	29
Mikulicz's exteriorization	33	7	21
Anastomosis over—Clamps	18	4	22
Anastomosis over Combined abdominoperineal	10	1	10
Total	192	39	20

believe that this gives a reasonably fair representation of the methods used. It must be added that some procedures were more successful in some hands than in others. The extent of the disease, the age and condition of the patient, the degree of obstruction, infection, complicating diseases, etc., played some rôle in the type of operation chosen. Certainly those patients subjected to a modified Mikulicz and the Jones modification of the "turn out" operation were of the older age group and poorer risks.

It is evident that the Parker-Kerr basting stitch method of suture,[5] as we have modified it in our clinic,[6] has given a lower mortality rate than any of the other methods used. (Fig. 5.) One must be prepared to carry out this technique in great detail or it will fail. The clamps used must be thin and strong. We have modified a long thin clamp with rigid, longitudinally serrated blades.[7] An Ochsner-Kocher tooth at the tip aids in proper alignment and meshing. The basting stitch must be pliable but not easily penetrated. Boilable 0 chromic catgut on atraumatic needles serves this purpose well. The non-boilable gut is softer and more easily penetrated or held in the tissue by the anastomosing sutures, thus making the withdrawal of the basting stitch more uncertain. The basting stitch must be properly marked, as one end may become tied accidentally to the anastomosing suture. This is easily accomplished if Kelly clamps are routinely placed on one and Ochsner's on the other basting sutures.

One may use a single row of silk mattress sutures as advocated by Halsted, but we have had excellent results with two rows of very fine chromicized catgut. This makes it possible to place the outside posterior row of sutures before the clamps are removed, and thus the ends of the bowel are held together during the remaining steps of the anastomosis. This gives all the advantages of an anastomosis over clamps and eliminates the handicap of the clamp in introducing most of the sutures. A second row of sutures may not be necessary and if one uses interrupted stitches, it probably is best to use only one row. On the other hand, healing takes place from the serous coat of the bowel wall only, and a broader loosely held contact between the two segments seems desirable. This can be accomplished by running sutures locked or tied at the ends to prevent abnormal purse-string action.

The greatest care must be used to leave a small diaphragm at the anastomosis. This requires thin bladed clamps and the suture lines placed as near them as is feasible. On the average large bowel, the two lines of sutures which we use would be approximately ⅛ to 3/16 of an inch apart.

It is wise to withdraw the basting stitches after the two posterior rows and the inside anterior row have been placed. The seared edges of the bowel should be carefully broken up with thumb and finger after the final anterior row of sutures has been made. If the mesentery is thickened

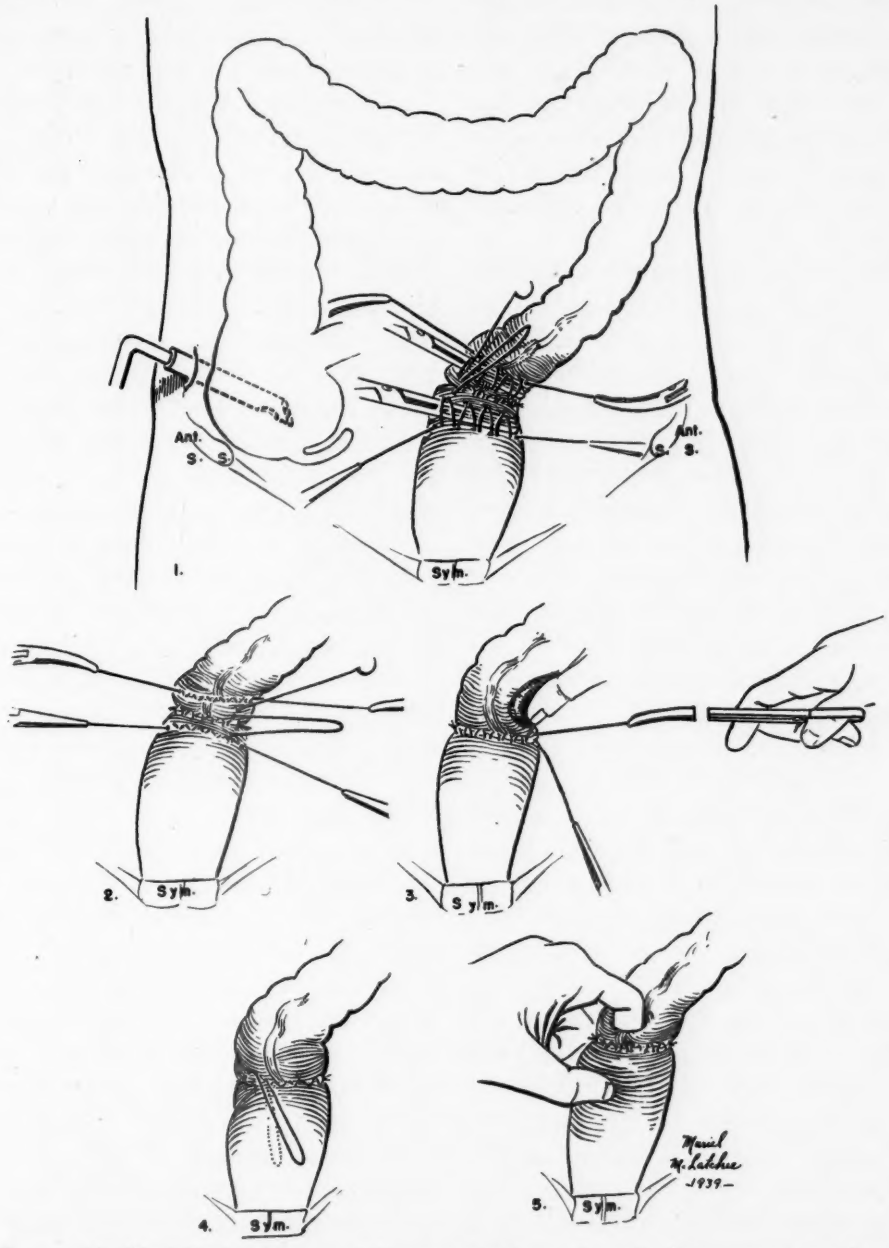

Fig. 5. Modified Parker-Kerr aseptic anastomosis. 1, A preliminary cecostomy has been done at a previous operation. The tumor area has been resected. Basting sutures are in place. The outer posterior row of sutures is being applied. 2, The special clamps have been withdrawn. The inner posterior layer has been started. 3, The two posterior layers and the inner anterior layer have been completed. The basting stitches have been cut and are being withdrawn. 4, The final layer of sutures is being completed. 5, The thumb and forefinger are passed through the anastomosis.

by fat, one may do well to adopt the suggestion of Owings and Stone[8] of applying the clamps in such a manner that the mesenteric border is in the center of the clamp rather than at its edge. Another important detail is not to disturb the fat tabs along the edge of the bowel to be sutured. Many times leakage occurs because the bowel is thus denuded of its blood supply with resulting spontaneous necrosis.

The use of various clamps over which an anastomosis is made, has been successful in the hands of many surgeons. Rankin,[9] Furness,[10] Young,[11] Stone[8] and others have devised instruments for this purpose. These methods have the advantage of eliminating the complicated use of the basting thread with its technical pitfalls. Doubtless with experience and practice, one can use any device that best suits his purpose. One is desirous of approximating the two cut ends of the bowel in a manner that in his hands he can (1) establish satisfactory continuity; (2) produce the minimum of contamination; and (3) obtain a satisfactory end result.

There are thoughtful surgeons who feel that the certainty of an anastomosis under vision is more desirable than attempted asepsis. As our figures show, we have had considerable experience with open anastomosis in our clinic. The results have been good, due to the fact that gross soiling has been avoided. The area is well walled off, the bowel contents kept under control, and as soon as the anastomosis is complete and before the toilet of the peritoneum is begun, all soiled instruments, drapes, and gloves are discarded. This method gives the peritoneum a chance to demonstrate its natural immunity to infection. If the bowel has been well prepared and one does not have to contend with liquid fecal matter, the percentage of successful open anastomoses is large.

At this time, we feel that the possible benefits of peritoneal vaccination should be discussed. We have purposely avoided routine preoperative vaccination other than that possibly obtained by a preliminary proximal drainage or short circuit procedure. It has been our contention that vaccination carried with it some risk in itself and that it very definitely had a tendency to make the surgeon less careful in his technique. We are now convinced that there is a use for vaccination on the basis of the research of Steinberg,[12] as well as that of Coller, Ransom and Rife.[13] We do not advocate preliminary vaccination as a routine but we do feel that any large bowel resection contemplated in one stage should have vaccination beforehand. Inasmuch as we are two-stage advocates, at the present time it is obvious that we have more faith in the divided procedure than we do in vaccination. The term peritoneal immunity is a broad one and since the flora of the intestinal tract varies so widely, it is difficult for us to see how gross contamination can be combated by any method of preliminary vaccination. On the other hand, if contamination takes place accidentally at the time of operation or if early peritonitis is already present, then certainly one is justified in any method that, by careful laboratory studies, indicates a rapid immunity to invading organisms. If one can, without harm to the patient, increase his resistance to spreading peritonitis, one should certainly do so. We warn against placing trust in vaccine rather than careful surgical principles, but use it as an adjunct to good technique, if at all.

If one feels more secure with exteriorization operations, the obstructive resection advocated by Rankin[14] is the most logical. The development of the exteriorization operation is usually credited to Mikulicz.[15] He popularized the procedure originally used by Bloch.[16] Paul's operation,[17] which involved the immediate removal of the exteriorized bowel, preceded that of Mikulicz, and, in view of our present knowledge, is superior. Rankin's operation allows an adequate dissection of the mesentery and the removal of a wide margin of bowel on both sides of the growth. It also makes possible the immediate removal of the diseased structures with the actual cautery between clamps, thus avoiding contamina-

tion of the wound and peritoneal cavity with bowel contents. It also eliminates the possible implantation of cancer cells in the wound, which so often took place by the original Bloch-Mikulicz operation. We acknowledge the safety of this procedure from the standpoint of mortality and cure. Our objection to it is the long disability due to the difficulty in obtaining a satisfactory or spontaneous reëstablishment of the fecal stream. So often a deferred closure of the fistula must be done, thus amounting after all to a two-stage operation. These objections are of no great basic importance and they are offset by the good results obtained by many surgeons who use the method.

The modification of the "turn-out" operation, as advocated by D. F. Jones, has a definite place in this discussion.

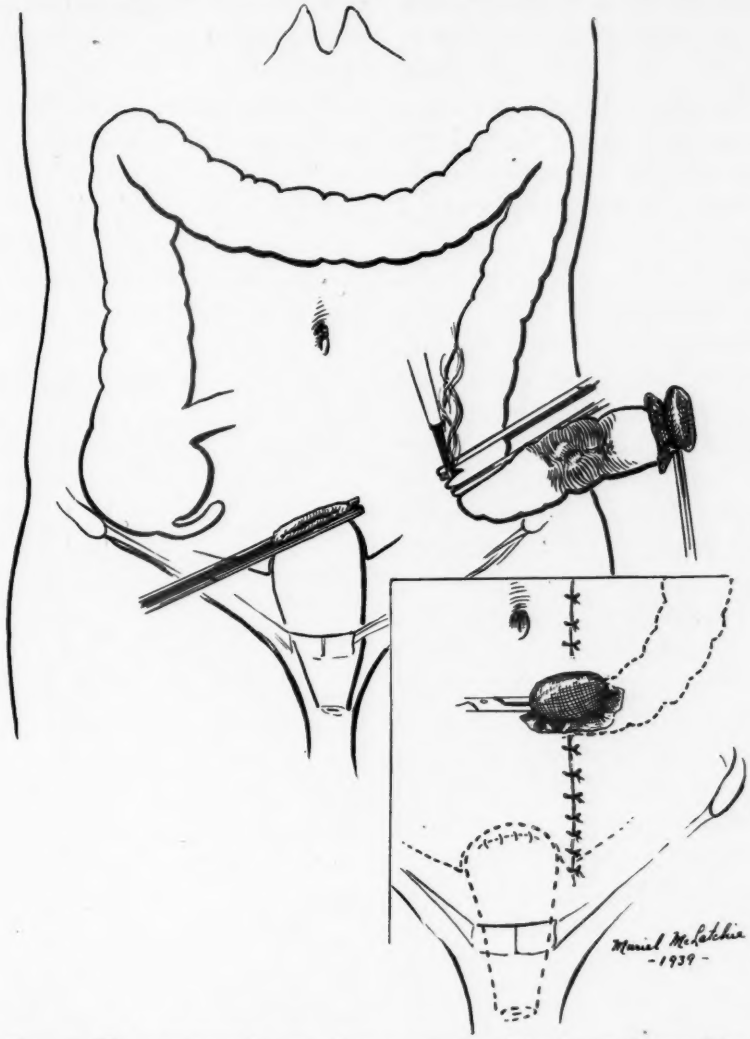

Fig. 6. The "turn-out" operation as practiced by D. F. Jones. The rectal stump is too short for anastomosis. It must not be buried below the pelvic floor.

(Fig. 6.) Often a growth near the pelvic floor is too low to allow a safe or satisfactory anastomosis. The patient may be too feeble to allow the added strain of lowering the pelvic floor as described by Rankin. The disease may be removable by dividing the bowel with the cautery below the growth, inverting the rectal stump, and turning out the diseased area which can then be burnt off at a suitable level to leave a satisfactory end colostomy. Often in the aged, particularly in the male, this will prove a safer procedure than combined abdominoperineal excision and quite as

satisfactory. One should take care never to bury the rectal stump below the peritoneal floor unless the patient is turned after the abdomen is closed and drainage established to the ischiorectal fossa. If the stump is turned in flush with or above the peritoneum from within the abdomen, drainage is unnecessary unless there has been accidental contamination of the pelvic retroperitoneal tissues. If one leaves a blind stump of rectum, it is necessary to caution the patient to cleanse this segment at least once a month, otherwise a firm white accumulation of mucus will collect, causing occasional diarrhea from the colostomy through the nerve impulse of defecation or an uncomfortable feeling of pressure in the perineum. This may be avoided, if it presents a real problem, by dividing the sphincter muscles completely, thus allowing the secretion to escape as it forms.

The five-year curability has been calculated for the eight-year period 1925–1932. Counting all lost cases as dead, 71 per cent of those patients surviving a radical resection of a right colon cancer were alive five years after operation, 40 per cent with one of the transverse, and 37 per cent of those with a cancer of the left colon. If operative deaths are included, the five-year curability percentages are 47 per cent, 28 per cent, and 25 per cent respectively.

SUMMARY AND CONCLUSIONS

Carcinoma of the colon is a favorable site for cure, yet it accounted for at least 11 per cent of the deaths from cancer in the United States during the year 1936.

The disease produces early characteristic symptoms that should be recognized by the physician and by the patient.

The earlier the operation, the safer the procedure and the better chance for cure.

The average delay between onset of symptoms and admission to the hospital in our group was eight months.

Radical resections were possible in 58 per cent of a group of 618 admissions.

The mortality from radical operation was approximately 20 per cent in one-stage as compared to 13 per cent in the two-stage procedures.

The greatest percentage of five-year cures was in the right colon—yet the mortality of operation in one stage is much greater on the right than on the left bowel.

Aseptic resections particularly with two-stage Parker-Kerr anastomosis gave the lowest mortality.

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EXAMINATION AND CLASSIFICATION OF TUMORS OF THE RECTUM AND COLON

C. E. DUKES, M.D.

Pathologist, St. Mark's Hospital

LONDON, ENGLAND

Initial Treatment of Operation Specimen. The French have a proverb, "C'est le premier pas qui coûte," which may be translated "The first step counts most." This is as true for the examination of operation specimens of intestinal tumors as it is of many other things in this world.

This first step is to open up the intestine with a pair of scissors along the anterior midline, gently washing away any intestinal contents with tap water. Then without further delay the specimen should be pinned out on a cork mat or sewed to a frame. The opening up and pinning out must be done before fixation with formalin. The operation specimen should never be placed direct into formalin or other fixative fluid. This would be a step in the wrong direction, because immediately after fixation the tissues begin to shrink and would become so distorted that it would be difficult to get a good surface view of the growth and the surrounding mucous membrane. It is not essential that the specimen should be opened up and pinned out immediately upon its removal from the body. It can be left for several hours provided that it is left severely alone, unwashed and unfixed.

We have a rule at this hospital that as soon as the rectum or colon is removed in the operating theater it is sent direct to the laboratory in a dish. The laboratory technician on duty then opens it up and sews it to a frame and sends back to the theater the pinned out specimen, washed and soaking in dilute formalin so that the surgeon may see it at the end of the operation.

The frame is shown in the accompanying photograph. (Fig. 1.) It consists of mecanno perforated strips with adjustable cross bars. Attachment to this frame is secured by stitching with needle and twine, the sutures being kept taut so that the intestine retains its natural length and breadth. In operation specimens of cancer of the rectum the ligature which the surgeon ties round the inferior mesenteric pedicle should also be tied to the upper end of the frame to keep the vessels taut. Stretched on this frame the intestine should be immersed for one to two days in a tall jar containing ten percent formalin.

Examination of Operation Specimen. After the operation specimen has been fixed it may be taken from the frame and washed thoroughly with water. It is then inspected and certain measurements recorded. These include the total length of intestine removed, the size of the tumor, and its character (i.e., whether it is fungating, flat, or ulcerated); the quadrants of bowel affected; the relationship to anatomic landmarks such as the anorectal line, or the peritoneal reflexion, and the amount of free margin of bowel at the proximal end.

The next step is to form an estimate of the extent of local spread. Some information on this question can be obtained by feeling the perirectal or pericolic fat adjacent to the growth. The impression formed in this way should be checked later by cutting a slice transversely through the tumor at its point of maximum ulceration. The margin of the tumor is usually quite easily seen when the growth is sliced in this way. (Fig. 2.) In the case of rectal cancer the special points to notice are whether or not the growth has spread by direct continuity through the rectal muscle into the perirectal fat, and if so, to what degree.

Local Spread. As a general rule it will be found that the more deeply ulcerated the tumor, the greater will be the extent of

local spread in the perirectal or pericolic fat. Cancer begins within the mucous membrane and forms in the first place a nodular projecting growth slightly raised above the adjoining surface. As the growth continues the tumor spreads by extension on the surface and by invasion of the underlying tissues. Increase of the malignant tissue proceeds in both these directions at the same time, but in some tumors the surface extension is slight, in others massive.

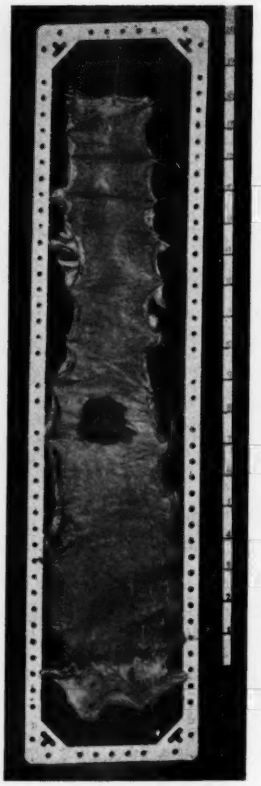

Fig. 1. Operation specimen of cancer of rectum stretched on frame ready for fixation. (From Gabriel, Dukes and Bussey, in *Brit. J. Surg.*, 23: 395, 1935.)

Fig. 2. Longitudinal slice through wall of rectum showing local spread of carcinoma into perirectal fat and large lymphatic metastasis above. (From Annual Report, British Empire Cancer Campaign, 1935.)

Invasion of underlying tissue results in an alteration in the surface contour of a tumor. This does not become noticeable while the growth is limited to the mucous membrane and submucosa, but as the malignant tissue pushes its way into the circular muscle the nutrition of the surface layers of the growth becomes impaired and ulceration commences. Further infiltration of the bowel muscle and spread into the perirectal or pericolic fat results in deeper ulceration.

In the case of cancer of the rectum the facts about local spread may be expressed in a few words. The extent of growth in a longitudinal or lateral direction can be seen from the surface. The extent of deep penetration can be estimated from the depth of the ulceration. Flat or projecting tumors are not likely to have spread far beneath the surface but deep ulceration is always a sign of deep extension.

Lymphatic Spread. The lymph nodes lie in the perirectal and pericolic fat and the adjacent mesentery, the connecting lymphatic vessels running near the veins. The

first lymph nodes to be affected in cancer of the rectum and colon are the regional group. Therefore, as many of these as can be found should be removed for microscopic examination. It is important also in the case of rectal cancer to remove separately for examination any lymph nodes found near the point at which the inferior mesenteric or superior hemorrhoidal vessels have been ligatured. The first direction of lymphatic spread in all rectal cancers (except growths situated in the lower third) is upwards along the hemorrhoidal lymph chain. If metastases are found in the regional lymph nodes only, and the upper hemorrhoidal glands are free, the prognosis is better than if all the lymph nodes contain metastases.

If the pathologist can find time for a more thorough procedure he will find that the interest of the case is increased both for himself and for the surgeon if he is able to make a map to indicate the position and size of each metastasis. This method has been developed by my colleague, Mr. H. J. R. Bussey, who makes a natural size drawing of each operation specimen sent for examination at St. Mark's Hospital, and records the exact position and size of each lymph node. As far as possible each node is bisected and one half taken for section, the other being left in situ, but with smaller nodes it is necessary to take all for section. The lymph nodes are blocked in batches. After microscopic examination the position of the metastases is marked on the map by inking in the affected places. The drawing is then photographed, and a photograph of the tumor itself and also of the gland dissection are attached to the pathologist's report. (Fig. 3.)

Venous Spread. A search should be made also for evidence of venous spread. This may take the form of a widespread permeation of the perivascular lymphatics or of thrombosis and growth within the veins. It is not common to find extensive spread within the veins, but if this is observed and confirmed by microscopic examination it may be taken for granted that the patient has hepatic metastases.

Form of Pathologic Report. The pathologist's report should describe the size and position of the growth and its histologic character. It should also describe the extent of the local spread and state whether there is any sign of venous dissemination, and give some idea of the number and position of the lymphatic metastases. If the information is set out in this way the report will answer two questions in which the surgeon is deeply interested, namely: (1) How fast was the tumor growing? and (2) How far had it spread?

A

Fig. 3. A, surface view of operation specimen. An ulcerating tumor completely encircles the rectosigmoid. B, photograph of gland dissection. The primary growth and glandular metastases are marked in black. (From Dukes in *J. Tech. Methods & Bull. Internat. A. Med. Museums*, 15: 46, 1936.)

Rate of Growth. The rate of growth of cancer of the intestine is reflected in the histology of the tumor. As a general rule, a

growth which is well differentiated in character, closely resembling the tissue from which it is derived, is relatively benign and proceeds comparatively slowly. On the other hand a growth which is very poorly differentiated, having little resemblance to its parent tissue, is undoubtedly highly malignant and grows at a rapid rate. Broders (1925 and 1928) put this system of classification on a more exact basis by defining four grades of malignancy according to the degree of differentiation of the tumor cells. The value of this method of classification has been confirmed by several writers including myself (1937). The information derived from grading is particularly useful if the tumor is found to be either grade 1 or 4. Grade 1 tumors grow very slowly and metastasize late, whereas grade 4 neoplasms grow very rapidly and metastasize early.

Extent of Spread. If the examination of the operation specimen has been carried out in the way described it is possible also for the pathologist in his report to answer the second question: "How far had the growth spread?" At this hospital we divide cancer of the rectum into three groups—A, B, and C—according to the extent of spread (Dukes, 1932). (Fig. 4.) Cases of group A are those in which the cancer is limited to the rectal wall and there is no spread in the perirectal fat. B cases are those in which the growth has spread by direct continuity into the perirectal fat but the lymphatic glands are free from metastases. C cases are those with lymphatic metastases. Table 1 shows the results of perineal excision in the three groups, the figure in the last column being obtained from the customary fraction:

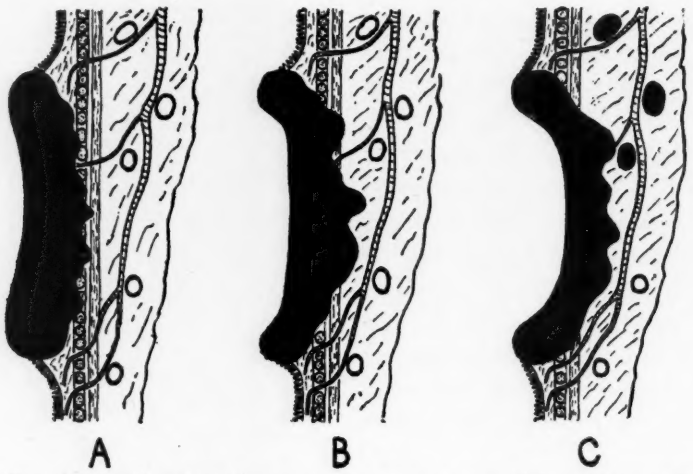

FIG. 4. Classification of cancer of rectum. A, growth limited to wall of rectum. B, extension of growth to extrarectal tissues but no metastases in regional lymph nodes. C, metastases in regional lymph nodes. (From Dukes in *Proc. Roy. Soc. Med.*, 33: 25, 1937.)

$$\frac{\text{Alive at 5 years} \times 100}{\text{Operation survivals less those untraced and died from other causes}}$$

TABLE 1

RESULTS OF PERINEAL EXCISION AT FIVE YEARS CLASSIFIED ACCORDING TO EXTENT OF SPREAD

Classification of Growth	Total Number of Cases 1927–May, 1930	Died from Operation	Died under Five Years		Untraced	Alive at Five Years	Percentage of Five Year Survivals
			Of Other Causes	Of Cancer			
A	24	..	2	2	..	20	91
B	36	1	5	10	2	18	64
C	34	6	3	21	..	4	16

SUMMARY

This paper describes how an operation specimen of cancer of the intestine should

be pinned out and fixed. It describes the method of deciding the extent of local and lymphatic spread. If the specimen is examined in this way the pathologist is able to record the size and position of the tumor, its rate of growth (histologic malignancy grade) and its extent of spread (A, B, and C classification).

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It is fair to state that all patients having symptoms from internal hemorrhoids can be given relief in greater or less degree by injection of the hemorrhoids.

The brief excerpts in this issue have been quoted from "The Rectum and Colon" by E. Parker Hayden (Lea & Febiger, Philadelphia).

EXPERIENCES WITH RESECTION OF THE COLON AND THE ELIMINATION OF COLOSTOMY*

W. WAYNE BABCOCK, M.D.

PHILADELPHIA, PENNSYLVANIA

RESECTION of the large intestine may be indicated for specific or non-specific granulomatous disease, for ulceration, diverticulitis, polyposis, other benign tumors, but especially for that very prevalent condition, cancer. In no other internal organ with the exception of the larynx is cancer as curable by operation, and in only one other is it as common as in the colon. Intrinsic cancer of the larynx has a nearly 100 per cent operability rate, and with an operative mortality of about 3 per cent, hardly 15 per cent of the growths recur after laryngectomy. Despite many delays in diagnosis from 60 to 80 per cent of the cancers of the large bowel now are operable when the patient is hospitalized. The operative mortality for patients who have not reached the stage of complications such as obstruction, perforation or metastasis has with the experience and the technical improvements of recent years been reduced to about 10 per cent or even less. After radical resection about 40 per cent of the patients remain free from evidence of recurrence after five years. In contrast, hardly 20 per cent of patients with carcinoma of the stomach reach the hospital while radically operable, and scarcely three out of one hundred are living and free from the disease five years after the operation. Grouping the types of cancer of the uterus and adnexa treated by irradiation, operation or both, a 30 per cent survival five years after initial treatment is very creditable. The better results from hysterectomy for the less malignant and rarer adenocarcinoma of the corpus uteri are outweighed by relapses after irradiation or operation for carcinoma of the cervix or ovaries. Nephrectomy for malignancy of the kidney has an even lower curability rate from the predominance of tumors of the hypernephroma type over the less diffusible papillary cancers of the renal pelvis. By contrast the patient with early cancer of the colon has a particularly hopeful outlook with much more to lose from delay in diagnosis or defect in treatment.

The treatment of carcinoma of the colon is the early and radical removal en masse of the affected segment with 7 cm. or more of normal appearing bowel on each side of the tumor; together with the associated mesentery, tributary lymphatics and if possible any other involved tissues. The presence of small metastatic nodules in the liver or of enlarged cancerous glands along the aorta, does not in my opinion always contraindicate the removal of a resectable primary tumor. By the removal of the original growth the patient is largely relieved of obstructive symptoms, hemorrhage, foul discharge, absorption from the sloughing tumor and invasion of adjacent parts, and usually shows a marked improvement mentally and physically. Often he is able to resume his work for a year or more, and finally passes out after a relatively painless decline.

In 252 operations for cancer of the colon we found metastasis to the liver in thirty-three. In twelve the invasion of the liver was far advanced or the primary lesion irremovable. A palliative colostomy was done in six and a simple exploration in six. In the remaining twenty-one patients the primary growth was resected with three deaths (14 per cent mortality). A proctosigmoidectomy with perineal anus was done in thirteen, a Mikulicz-Paul stage resection in six and a resection with end-to-end anastomosis in two. Of nineteen pa-

* From the Surgical Department of Temple University, Philadelphia.

tients surviving the operation most have lived over a year, four over two years, one woman now 75 years old is active and comfortable after four and one-half years.

Carcinoma of the large bowel may exist for two years or more without metastasis. In our series, symptoms such as colic, melena, change in bowel habit in the form of diarrhea or constipation, or physical evidence of the growth had existed for from a few months to over five years before the patient sought relief by operation.

The spread of cancer of the colon is chiefly through the lymphatics and portal circulation. Our experience confirms the findings of Miles that the lymphatic drift from cancer of the bowel is upward. We recall no case of lymphatic invasion caudal to the lesion in the bowel, nor in our series have we observed gross evidence of involvement of the inguinal lymphatics, even from anorectal growths. Metastasis to the skeleton is much less frequent (5 per cent) than to the lymphatics or liver, but may occur early. Quite striking is the relative, slight tendency toward peritoneal diffusion as contrasted with carcinoma of the ovaries, stomach and other organs. Even with colonic growths of long duration it is usual to find only small peritoneal nodules in a radius of but a few centimeters on the peritoneal leaflets adjacent to the tumor. In contrast is the predominant local invasive tendency of the cancer. It tends to ulcerate early, to invade the submucosa and muscularis to the peritoneum, and later to attach to and invade adjacent structures, as the bladder, small intestine, vagina, uterus, broad ligament or abdominal wall. Beginning in the transverse colon we have seen attachment and local invasion of the pancreas and a simultaneous perforation and proliferation in both the stomach and small intestine. In such cases if there is no clinical evidence of metastasis we have resected the involved colon with the attached involved uterus or involved portions of vaginal wall, bladder, small intestine, stomach, pancreas or other removable tissue.

The tendency in many cases for carcinoma of the bowel to remain localized for many months should stimulate the surgeon to undertake a very radical procedure even though excision has been considered impossible at a previous operation, and although a palliative colostomy has been done. Formidable adhesions may be found quite benign and infiltrative thickening about ureters and great vessels only inflammatory. I know of few situations of carcinoma in which a previous opinion of inoperability should so often be discounted. On the other hand, too frequently we find the rarely mistakable infiltration of cartilaginous hardness, the "frozen" pelvis, or the soft grayish material of a degenerated carcinoma invading parts that are not surgically removable.

The local invasion of the growth has two important clinical applications. The base of the ulcer is commonly thin and easily perforated by biopsy, or the necrosis produced by radium, fulguration or electric desiccation. We have seen the secondary peritonitis and localized abscess following a biopsy block an attempt at radical extirpation of the carcinomatous bowel. The malignant ulcer has such an unmistakable clinical picture with its hard, infiltrating, ragged, raised and rolled borders and central, depressed, irregular crater that the diagnosis can very positively be made by palpation alone. Nearly as reliable is the appearance of the growth as seen through a proctoscope.

I have never seen a mistake made in diagnosing an ulcerating rectal carcinoma by palpation alone, and therefore consider a biopsy both dangerous and unnecessary in this type. Should biopsy be used, only a portion of raised border above the level of the floor of the ulcer should be removed. With projecting polypoid or adenomatous growths a biopsy is relatively safe and is desirable, as with benign clinical features histologic evidence of malignancy may be found. Likewise, except to remove small superficial or polypoid adenomatous growths or to restore temporarily a lumen

through an obstructing irremovable fungating cancer, treatment by electrical destructive or other local measures should be strongly condemned. Local treatment not only fails to remove involved lymphatics, but histologic studies show the fallacy of attempting to destroy the primary carcinoma without the full thickness of the bowel. The treatment may reduce bleeding, delay or temporarily overcome intestinal obstruction and thus give the patient a measure of relief and much hope of cure. As with irradiation we find these patients after months of dangerous delay drifting to the surgical clinic for operative relief. A rather long duration of life may erroneously be ascribed to the treatment.

Patients with cancer of the colon who escape a fatal obstruction or perforation not infrequently live four or five years and some an equally long period after metastasis has developed. One of our patients with rectal cancer who was refused operation because of extensive metastasis in the pelvic bones lived five years and was quite comfortable until the last six months of his life. A woman now 75 years old, at the time we resected the colon, January 6, 1935, had metastatic nodules in the liver, yet she now considers herself in good health for her age. As her tumors had doubtless existed for some time before the operation it is evident that any harmless treatment used might have been credited with the prolongation of life. Even in young patients, symptoms referable to the disease may apparently cover several years, as in the case of a very robust and muscular man of 24, who for about three years had as his only symptom occasional transient attacks of severe obstructive intestinal colic after excess in eating. Finally after attending three parties and eating three lunches in one afternoon he developed complete obstruction and at operation an advanced carcinoma of the colon was found.

Irradiation by *x*-ray or radium has in no case of which I have personal knowledge been curative. Heavy irradiation used before or after operation I consider harmful and in several instances it has left patients who otherwise would be well with distressing vesical, intestinal and cutaneous changes and an irradiation neuritis, which usually torments the patient as long as he lives. A few patients with advanced intestinal cancer think they have obtained a little solace from a very mild and relatively innocuous irradiation.

Spinal anesthesia has been used in nearly all our resections of the colon without mortality or serious complication thanks to our very efficient assistants. Although 37 per cent of our patients were between 60 and 79 years of age, serious postoperative pulmonary complications, except from metastatic growths, have been infrequent. The intradural injection of 100 mg. of pontocaine mixed with 55 mg. of procaine is favored on account of its prolonged action. As a rule this is immediately followed by 100 to 250 c.c. of a 1 per cent epinephrinized procaine solution, injected locally. During the operation, if the patient is asthenic, from 500 to 1,000 c.c. of 5 per cent glucose, possibly followed by 300 c.c. of typed citrated blood, is slowly run into a vein. Especially for secondary operations upon patients in very poor physical condition evipal and glucose infusion, combined with local anesthesia, have been very satisfactory to the operator and of great comfort to the patient. A slow intravenous infusion of 5 per cent glucose is started and continued during the operation. As the patient slowly counts, a 2.5 to 5 per cent solution of evipal is injected through the rubber tube close to the intravenous needle, at the rate of about 1 c.c. every ten or fifteen seconds. When the patient stops counting, the evipal is instantly discontinued, the abdominal incision quickly made and the abdominal wall and subperitoneal layers freely infiltrated with a 1 per cent solution of procaine containing 1 minim of epinephrine to each 10 c.c. With a pump syringe and a 20 or 22-gauge needle, from 250 to 500 c.c. of the solution are quickly injected. With this combination little additional evipal may be required and an asthenic patient may doze

through an operation lasting an hour and a half from a total of only .6 or .8 Gm. of evipal. If the injection is made at the ankle

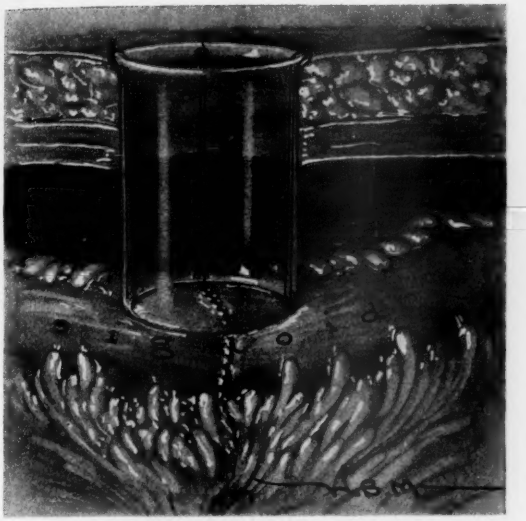


Fig. 1. Glass lamp chimney drain, attached by four wire sutures over an intestinal anastomosis. The drain is not fastened to the skin.

the body should be tilted head downward, as otherwise a dangerous accumulation of the drug in the lower extremity may occur before an appreciable effect is noted. If indicated, carefully typed citrated blood follows the glucose infusion.

It is not uncommon to find the patient in better condition at the end than at the beginning of an extensive operation, and in no case during recent years has sufficient shock occurred under either method of anesthesia to prevent the completion of a radical one-stage operation.

Incision. During recent years for resection of the colon for malignancy or inflammatory disease we have used oblique lateral incisions of the muscle-splitting rectus retracting type almost exclusively. Exception is made if a scar from a previous operation lies adjacent to the operative field. The excision of such a scar better enables the division of postoperative adhesions, the possible correction of an incisional weakness or the avoidance of additional complications in the abdominal wall. Fever, leucocytosis, induration of the parietes, tenderness or fixed mass suggest infection, pericolitis, perforation or abscess and especially indicate the desirability of a direct approach by an oblique muscle-splitting incision placed over the lesion.

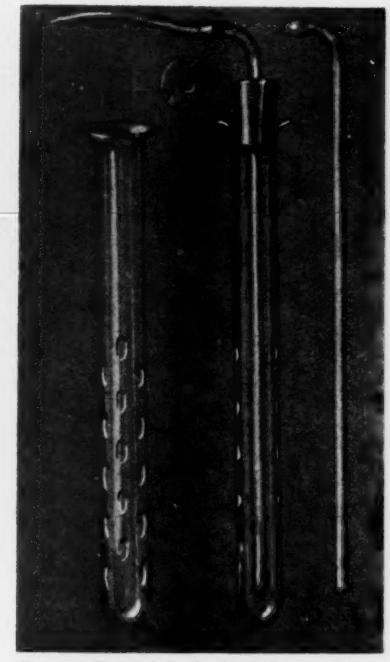


Fig. 2. Sump drain for the continuous evacuation of blood and other fluids that collect in the abdomen after an operation and that might lead to a spreading peritonitis.

Through such an incision infiltrated abdominal wall may be resected, an abscess may be drained, infected bowel delivered and necrotic tissue cared for with the least possible contamination of the general peritoneal cavity, and with the lowest percentage of hernias from a drained or contaminated wound.

These incisions run parallel with the fibers of the external oblique muscle and nerves of the abdominal wall and even after drainage usually leave a fine linear scar. (Fig. 6.) Additional room, if necessary, is obtained by dividing the anterior and, where present, the posterior sheath of the rectus, and by retracting or dividing the rectus muscle. The lateral extension of this type of incision gives good access to the deeply placed ascending or descending colon and facilitates the liberation and exteriorization of the bowel in a Mikulicz type of resection.

The alloy steel wire sutures with which we began to experiment in 1932 have proved of great advantage for closure of the bowel or abdominal wound. (Fig. 5.) They do not hold or transmit infection, do not irritate, rarely form fistulous tracts, and therefore do not delay the healing of an infected wound. Either no anesthetic or only a little local anesthetic is required for the secondary stages of a graded operation, the bowel being without pain fibers.

Fig. 3. Sump and lamp chimney drains with suction tubes guarding the suture line after a resection and anastomosis of the splenic flexure of the colon. Secondary intestinal leakage occurred in this case but with spontaneous closure of the fecal fistula and recovery.

For the right half of the colon a direct anastomosis has in our experience given a lower mortality than the Mikulicz type of operation, for both benign conditions and malignant tumors. Conversely for the left half of the colon the Mikulicz operation is considered safer than a one-stage anastomosis with a functional bowel. While the mortality from an end-to-end anastomosis in the left colon and sigmoid may be reduced by the use of "lamp chimney" and "sump" drains, we yet feel that the exteriorization stage type of operation is here safer, as it is in any case in which there is pericolitis or abscess.

The "lamp chimney" drains came into use in 1935 in our attempts to exteriorize and later, after adhesions had formed, to drain the septic gall-bladder. The device so nearly eliminated the mortality from operating for cholecystitis that the large glass tubes were then anchored over other infected areas and also over insecure intestinal anastomoses. (Fig. 1.) By adding a soft rubber tube carried to the bottom of the drain, fluid welling into the chimney may continuously be aspirated (Fig. 3.) The need for the prompt removal of septic fluids, blood and other culture media, as well as any free peritoneal fluid which may lead to a spreading peritonitis, is especially great after resection of the colon.

From difficulties in obtaining "up hill" drainage, more recently we had the glass-blower fashion simple glass "sumps" of various sizes and shapes. (Fig. 2.) These consist of an external collecting glass well or tube which has multiple perforations so small as to prevent herniation of bowel or omentum of the adult. The internal aspirating tube may be of glass or rubber and is attached to a suction device, preferably a collecting bottle connected with a motor driven suction pump, although a water spigot aspirator or Wangensteen apparatus may be used. In the hospital machine shop we have had the miniature

motor and pump assembled as a stopper for a wide mouthed collecting bottle. (Fig. 4.) This forms a portable single unit for nearly any aspirating service and uses but one tube from the patient. When used for an abdominal resection of the colon the suction drainage should be started during the operation and continued during the first twenty-four or forty-eight hours or until there is no further collection of fluid. It is especially important to remove blood so promptly that clots do not form and obstruct the tubes. The aspirating tube and any other tubes (catheter, enterostomy tubes) running from the patient or any pressure port on the aspirator should be marked plainly or so tagged as to avoid dangerous complications from wrong connections. It is obvious that the outer end of the collecting tube must remain open for the free entrance of air.

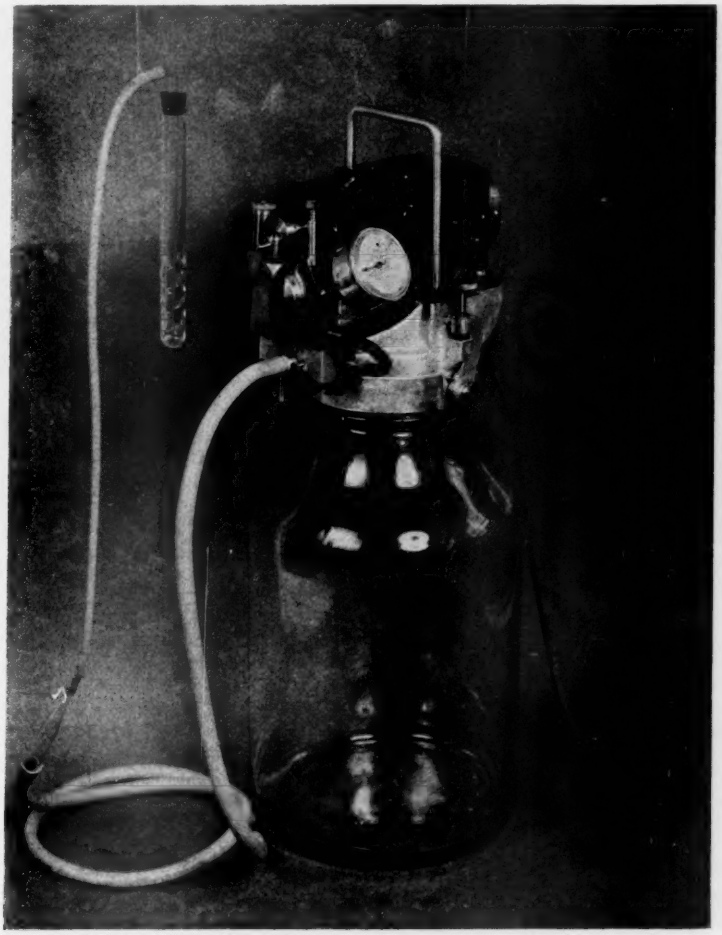


Fig. 4. Electric motor with suction pump and collecting bottle attached to glass sump drain for continuous aspiration of an abdominal wound.

Our present operative technique is as follows: The diagnosis of low-lying growths is made by the finger and proctoscope, or, for those above the pelvis, by barium enema and Roentgen study. Evacuation and decompression of the bowel before operation are obtained by laxatives and repeated irrigations carefully supervised. I have produced an acute obstruction by a large dose of castor oil.

For an unrelieved obstruction a cecostomy or appendicostomy is preferred as a preliminary ileostomy may lead to inanition from the heavy loss of water and nutriment, not fully compensable by diet,

transfusions and infusions. We have seen death follow the delayed closure of an ileostomy apparently from this cause alone.

drain) over the line of union, but not to the skin, with four fine alloy wire sutures. This tube is lightly covered with a gauze dress-

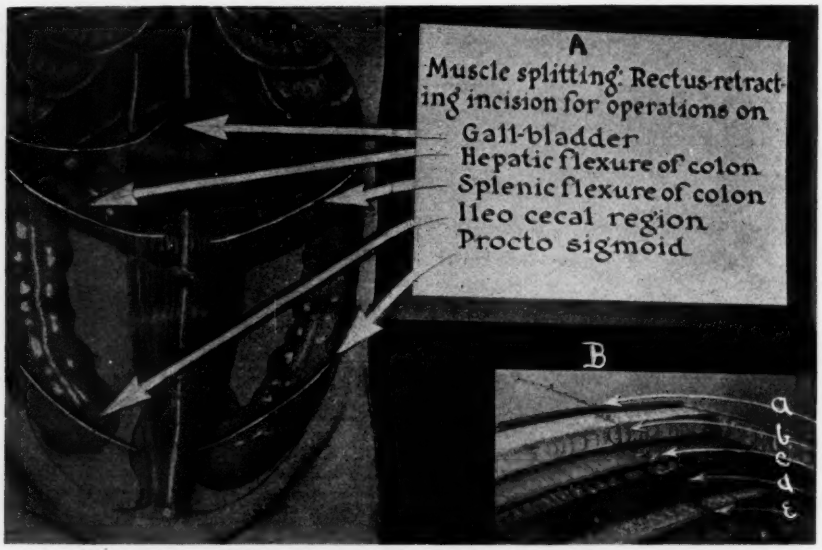


FIG. 5. A, muscle-splitting, rectus retracting incisions used in resection of the colon. B, abdominal wound closure with annealed alloy steel wire: *a*, continuous sutures of 38 wire for skin; *b*, interrupted 35 wire sutures for subcutaneous fat; *c*, *d*, *e*, interrupted layer sutures for aponeurosis, muscle and peritoneum. The wire is tied in a square knot and the ends cut very short.

During the preparation the general condition of the patient is studied and he is fortified by fluids and a low residue high caloric diet.

Selection of Operation. In removing the cecum and ascending colon usually a one-stage operation with end to end anastomosis is used. This also has given us the best results in ileitis. Cutting the ileum obliquely and properly spacing the sutures compensates for a difference in diameter between the ileum and colon.

The inner one or two rows of sutures may be of continuous chromic catgut or of silk, but for the outer row we prefer the fine alloy steel wire (gauge 35 to 38), the ends being cut very close to the square knot. Our experiments show that adhesions form even over very fine (00000) catgut or silk exposed on the surface of the peritoneum, but not over the alloy steel wire. As infection or necrosis along the suture lines frequently occurs, especially after anastomoses of the colon we think it wise to anchor a tubular glass drain (lamp chimney

ing and through it the united bowel is inspected daily for change of color as well as for offensive odor or high bacterial content of the fluid exudate upon the bowel. If the exudate is free from bacterial contamination at the end of 48 hours the holding sutures are cut and the tube withdrawn. Offensive odor usually is followed by leakage along the suture line and indicates that the tube should be left in place for from five to seven days or until adhesions have firmly walled off the area. In several of our patients these tubes have provided an adequate vent for intestinal contents when leakage has occurred and apparently have been life-saving. The fecal fistula which then develops usually closes spontaneously after removal of the glass tube.

No other substance with which our group has experimented, except stainless steel, produces as little irritation in the peritoneal cavity, as does glass. Buried in a dog's abdomen a glass tube remains free from plastic adhesion or exudate at the end of two weeks, while a rubber tube is then

encased in dense adhesions, and ulceration through the intestinal wall has started. It is to be remembered that isolating adhesions form very slowly about glass drains, a very desirable feature when prolonged drainage of the general abdominal cavity is necessary.

The tubular glass drain over the sutured bowel may fail to function when leakage occurs on the mesenteric surface or that opposite to the tube. If this is feared a curved suction drain should also be introduced to protect this area. Such a concealed leak may be suspected when the bowel and attached tube become elevated in the wound evidently from pressure from beneath the bowel; or by the pain, tympany, nausea, rising pulse and temperature, and the evidence of free gas and liquid in the abdominal cavity. The treatment is the prompt reopening of the wound and the exteriorization of the bowel ends to prevent further intraabdominal leakage. In many cases a proximal enterostomy also is desirable to relieve the associated inflammatory ileus, and suction (sump drains) should be introduced through the wound, and if there is turbid or odorous fluids, also to dependent portions of the abdominal cavity.

A side-to-side anastomosis is preferred by many operators for ileocolostomy as it conveniently enables the formation of a large stoma. The end of colon and ileum projecting proximal to the anastomosis should not exceed 5 cm. in length and should be securely inverted and well vascularized, as there is a tendency for the blind ends, especially that of the ileum, to become distended and to leak or cause colic.

For several years we have not used a side-to-side anastomosis. Resections in the transverse colon are complicated by the attached gastrocolic omentum and great omentum and by the lack of blood supply when the transverse colic artery is divided. In an obese person particularly, it may be difficult to free the colon from its fatty encasement without interrupting the circulation. In such a patient a Mikulicz operation may not be very practical even at the flexures and we have observed that along the bulky folds of retained fatty omentum,

Fig. 6. Scar from oblique muscle-splitting incision used for one-stage abdominoperineal resection of proctosigmoid with perineal anus.

infection may be carried from the open wound into the peritoneal cavity with resulting fatality. As a rule resection of the transverse colon except at the flexures should be complete. In the obese patient also an end-to-end anastomosis in the transverse colon is particularly subject to necrosis and leakage.

Anastomotic resections of the descending colon and sigmoid have a greater incidence of infection and leakage than those of the right colon, and therefore a higher mortality unless the fecal current has previously been diverted. As a result and also because the area is beyond the liquid absorbing part of the colon it is here that the Mikulicz-Paul type of operation is especially indicated.

For colonic malignancy the operation has been criticized and discarded as insufficiently radical. We have modified the technique so that a radical operation may be done and the convalescence shortened, as follows: (1) The cancerous bowel, mesentery and other attached invaded tissues are liberated wide of the growth and exteriorized en masse. The wide removal of

malignant tissue, an essential part of the operation, is much more important than the peritonealization of denuded surfaces or the formation of a long spur for later division. (2) If the arms of the liberated loop of colon can be apposed without tension, they may be sewed together along *anti-mesenteric* borders. Usually the sutures cause tension and may tear out or perforate the bowel and I omit them. (3) A narrow sump drain is introduced to be left in for twenty-four to forty-eight hours to keep the cavity free from blood and serum. (4) the wound is closed only with layer interrupted alloy steel wire sutures and ligatures to minimize infection. With a protective dressing in place the exteriorized mass is immediately cut away between clamps. (5) A right-angled glass tube with well rounded lower border, and attached Penrose rubber drain is then tied in each bowel end—*above the skin level.* (6) These glass tube vents are removed when leakage from necrosis occurs, usually from the fourth to the sixth day, and wet dressings of a 1 to 500 permanganate of potassium solution are applied and frequently changed to deodorize discharges. (7) After seven to ten days the necrotic bowel ends are trimmed, and gently liberated from the skin and subcutaneous fascia for suture. Where the arms of the loop of the bowel have been held in apposition by the closure of the wound a short spur has formed. This spur is divided a centimeter at a time, the edges being united with a follow-up suture of interrupted 35 or 36 alloy wire in a fine curved needle. By traction on the last two sutures introduced, the spur is elevated and stretched, facilitating further incision and the introduction of additional sutures. Care is taken not to open the peritoneal cavity. Finally, the bowel ends are united as far as is feasible with inverting wire sutures. The skin and fascia are left open, separated and elevated from the sutured bowel by a light gauze packing and the wet permanganate dressing continued.

The steps of the Mikulicz operation have thus been modified from such unfortunate experiences of myself or colleagues as: death from leaving an obstructive colostomy clamp on the bowel for two or more days; ischemic perforation and death from applying a spur clamp over the mesenteric border of the bowel or from using a devascularized loop; death from pressure perforation due to an indwelling colostomy tube and fatal spreading pyoderma of the abdominal wall from failure adequately to drain the subcutaneous fat after a Mikulicz operation.

In the method just described, as the spur is divided under vision and the edges united by sutures, there is less danger of perforation and leakage and much less necrosis than when the crushing clamp is used. The suture method is nearly painless and relieves the patient of the days of distress and sloughing accompanying the use of the clamp. From the short loop used the union obtained is often more of an end-to-end anastomosis than the side-to-side junction of the Mikulicz procedure. Occasionally with the wire sutures we have had the bowel closed and the patient ambulant by the twelfth day after operation, but usually several steps are required.

Colostomy. As nearly all patients object to an abdominal colostomy, I have given much attention to the preservation of a perineal opening. With resection of the colon above the midsigmoid this is not difficult, and with involvement of the lower sigmoid and even the rectosigmoid junction by carefully liberating the pelvic colon to the floor of the pelvis, it is at times possible by traction to deliver the upper rectum through a lower left inguinal incision with sufficient room below the growth to apply a clamp close to the skin and remove the involved segment. An angled glass tube is at once tied in the proximal end of the sigmoid and the cancerous loop with attached mesentery excised. Should the cancer involve much of the rectum, or the patient have a thick abdominal wall, an adequate excision by this method may be impossible, in which case the delivery and removal of the liberated rectosigmoid through the perineum is the preferred

operation. In a woman of 77 with very friable tissues, the rectum below the carcinoma parted. It was cleansed by passing antiseptic gauze through to the anus from above and a large cylindrical glass drain anchored over the open end of the rectum with four alloy wire sutures. The proximal rectosigmoid was excised, with formation of a colostomy. An uncomplicated recovery followed.

It is well recognized that resection of the obstructed colon has a high mortality unless the bowel is first decompressed by a colostomy, ileostomy or appendicostomy two or more weeks before the major operation. The appendix may be used provided it has a sufficient lumen and the obstruction has not reached a critical stage. It is delivered through a short muscle-splitting incision which is closed about the appendix without constricting or dividing the mesoappendix. The tip of the appendix is then amputated and a small soft rubber catheter threaded into the cecum which is gradually decompressed by repeated gentle irrigations, first with warm saline and later with a 5 per cent solution of peroxide of hydrogen. By daily withdrawing the catheter and substituting a well lubricated one of larger size, we have been able to insert a 27°F. rectal catheter through the appendix at the end of a week.

In many middle aged or elderly patients, however, the appendix is too atrophic to be used and a portion of the distended cecum or lower ileum is withdrawn through the muscle-splitting incision, a segment isolated and emptied with the aid of a non-traumatizing, curved rubber covered clamp. Two concentric purse-string sutures of fine silk are then introduced in the wall of the bowel, within which under the protection of surrounding pads, a puncture is made, and a 14 F. soft rubber catheter introduced and tied in. In closing the wound about the catheter it is best to use only alloy steel wire sutures and ligatures. The ends of the outer purse-string suture are brought outside the wound and tied around the catheter, after having also been used to anchor the bowel to the overlying edge of peritoneum. Under repeated and prolonged irrigation after the patient has been placed in a comfortable position in bed, the small catheter will usually be found adequate for the decompression of the obstructed bowel.

If the free peritoneal fluid is turbid or shows evidence of bacterial contamination, a long narrow sump drain should be introduced through the wound to the bottom of the pelvis and suction evacuation continued as long as liquid comes away.

This simple enterostomy with a small catheter having several openings is preferred because the introduction of a mushroom catheter is more difficult, necessitates a larger opening, and there is risk of greater contamination in the wound. From a larger and therefore stiffer rubber catheter we have seen fatal perforation of the bowel due to pressure of the tip of the catheter. In our experience the mortality of a formal colostomy with exteriorized loop for ileus from cancer of the colon is about 15 per cent or over. Where there has been a heavy impaction of solid feces above the obstructing carcinoma while a simple enterostomy and persistent irrigation will relieve the acute and dangerous symptoms, flushing from any single opening may be inadequate to liquefy and evacuate the nearly solid mass. Even with a through and through flushing alternately, discharging first from the rectum and then the proximal enterostomy, hours of effort perhaps repeated over several days and the use of many gallons of water may be required before the colon is emptied.

Devine* uses the proximal or the distal part of the transverse colon for the colostomy, unites the intra-abdominal arms of the loop with sutures and brings the ends of the divided colon through the recti and overlying skin by stab wounds placed 4 cm. apart. A month later the cancerous segment is excised. Realizing that it is not

* Sir Hugh Devine, Operation on a defunctioned distal colon. *Surgery*, 3: 165, 1938.

possible to sterilize the malignant area, he advocates one year's delay before uniting the resected bowel. Finally, the colostomy openings are enabled to close by introducing a blade of a special crushing clamp through each of the openings which creates a by-pass between the arms of the loop. The special advantages of the Devine procedure are the small and well separated colostomy openings which are distant from the operative field and are in some measure controlled by the pressure of the surrounding rectus muscles, the avoidance of a permanent colostomy and especially the empty, functionless bowel during the operative period. Objections to the method are the difficulties in forming the provisional colostomy in an obese patient, the four different operations required, and the fact that fifteen or more months are required for the completion of the various steps. Previous operators who have used a colostomy as a preliminary stage to the removal of the growth while they may have separated the openings and employed cleansing irrigations have, especially where the pelvic colon was involved, usually made the colostomy a permanent one.

In any such multi-stage procedure it should not be forgotten that each stage has its mortality and when the deaths from the separate operations are added, as they should be, the aggregate mortality is often higher than that from a single stage operation. The sterilization of a sloughing carcinoma of the bowel by irrigation of course is not to be expected.

Due to the prevalence of cancer in the sigmoid and pelvic colon this part is resected more frequently than any other portion of the intestine. The rectum, anus and lower sigmoid may be removed through the perineum, but the procedure has several objections. It will fail, unless combined with an abdominal operation, to remove invaded lymphatics about the brim of the pelvis or disclose other serious conditions in the abdomen, while in any extensive perineal liberation the blood supply of the portion of the bowel brought down usually is so interfered with that necrosis and the final formation of a narrow cicatricial and incontinent perineal opening results. The perineal operation has therefore fallen into disfavor, and largely has been replaced by a combined abdominoperineal procedure with the formation of an abdominal colostomy. Nevertheless, I believe that the perineal operation should be selected for anorectal and rectal growths in patients whose general condition indicates either a short expectancy of life or that the abdominal operation would be unduly hazardous, such as from marked obesity, advanced age or serious organic disease. The perineal operation also seems permissible when the growth is small, accessible and of the more superficial or less malign type.

In the removal of the carcinomatous bowel through the perineum, while the posterior vaginal wall has frequently been resected, during recent years we have not removed parts of the sacrum or rarely even the coccyx. The mortality is lower than that of any other resection of the large bowel, and with routine irrigations and perhaps the insertion of dilators, many of these patients live in relative comfort, although, as would be expected, the percentage of recurrences is greater than after the more radical abdominoperineal resection.

As for the abdominoperineal proctosigmoidectomy which is the preferred procedure for cancer of the lower sigmoid and pelvic colon, I believe that a single stage operation with perineal anus may be as radical, more aseptic, rather easier of execution and better for the patient than the conventional multiple or single stage procedures with the formation of a permanent abdominal colostomy. In general, surgical opinion contends that an operation without colostomy is less radical. However, in the operation we use, the ligations are placed as high, the section of bowel, mesentery and peritoneum removed is as great, and an associated panhysterectomy, or resection of the vagina, vesicles, prostate or pelvic floor is as feasible as with any

other operation. Moreover that the colostomy may not have been essential for a radical excision at the original operation is indicated by our ability to transfer such an opening from the abdominal wall to the perineum at a latter time.

The single stage operation with perineal outlet is done without crushing, dividing or opening the bowel until after the wounds have been sutured and dressings in place and therefore, should be more aseptic than one performed with an abdominal colostomy. In either case in the liberation of the cancer an inadvertent opening of friable bowel or an invasion of a septic focus may occur. That the patient prefers the perineal opening even without sphincter control is the testimony of those we have operated upon, as well as those who have had an abdominal colostomy transferred to the perineum. From about 110 such operations we have learned that a perineal sigmoidostomy has a convenience, an infrequent soiling and discharge of gas, and an expulsive power from the abdominal muscles unequaled by an abdominal colostomy. With regulated emptying of the colon, over one-half of the patients with the perineal opening can dispense with a protective pad and 85 per cent have infrequent soiling. With a few modifications the technique we now use follows the plan described in 1932.*

A muscle-splitting, rectus retracting incision parallel with and about 3 cm. above the left inguinal ligament is preferred. A hand is introduced through the incision and the abdomen explored from the liver and periaortic glands to the pelvic floor. The peritoneal leaflets of the sigmoid and rectum are divided wide of the growth, the ureters identified by their trombone movements and the left superior hemorrhoidal and inferior mesenteric arteries doubly ligated and divided near their points of origin. The peritoneal incision is continued around the brim of the pelvis and back of the bladder or cervix and the bowel, lymphatics and fat are separated by the hand from the sacrum and lateral pelvic walls to the pelvic floor. The middle and inferior hemorrhoidal vessels are divided well lateral to the bowel. The uterus and adnexa are freed with the bowel if invaded. If the vagina, prostate or vesicles are adherent to the growth, their separation is left for the perineal stage. At a point well above any evidence of malignancy, the mesosigmoid is divided to the bowel. If at this level the sigmoid is still viable as shown by pulsating or continuously bleeding vessels, a folded gauze tape 1 meter long is tied about the bowel and the ends packed against the floor of the pelvis. If the sigmoid is ischemic, the tape, which indicates the level for the artificial anus, is tied about the lowest segment of pulsating bowel.

Up to this time all effort has been devoted to the complete removal of malignant tissue. The next important step is to liberate 12 cm. (5 inches) of viable sigmoid or descending colon to reach from the posterior border of the pelvis to the perineal skin. To obtain this it may be necessary to divide the lateral peritoneal leaflet of the descending colon and other restraining bands. The liberated bowel is placed in the pelvis, the omentum pulled over the small intestine and the incision is closed in layers with interrupted 32 and 30 steel wire for the deep layers and interrupted continuous 35 and 38 wire for the skin. A sump drain is used only when there is contamination or unusual oozing. The rectum which had been irrigated and, just before beginning the operation, lightly packed with gauze wet with 3½ per cent tincture of iodine or tincture of mercuric chloride is now occluded by a purse-string suture about the anus.

Through an incision from the posterior border of the anus along the right side of the coccyx, the pelvis is entered and with the wound well retracted, the tape and attached liberated bowel and adnexa are withdrawn, taking care not to make

* Babcock, W. W. The operative treatment of carcinoma of the rectosigmoid with methods for the elimination of colostomy. *Surg., Gynec. & Obst.*, 55: 627, 632, 1932.

traction upon the friable cancerous mass. A perforated curved glass tube drain with small perforations is inserted along the the anal ring posteriorly and then to place the sigmoid in the mucous-lined anal groove. For fear of perforation the sigmoid

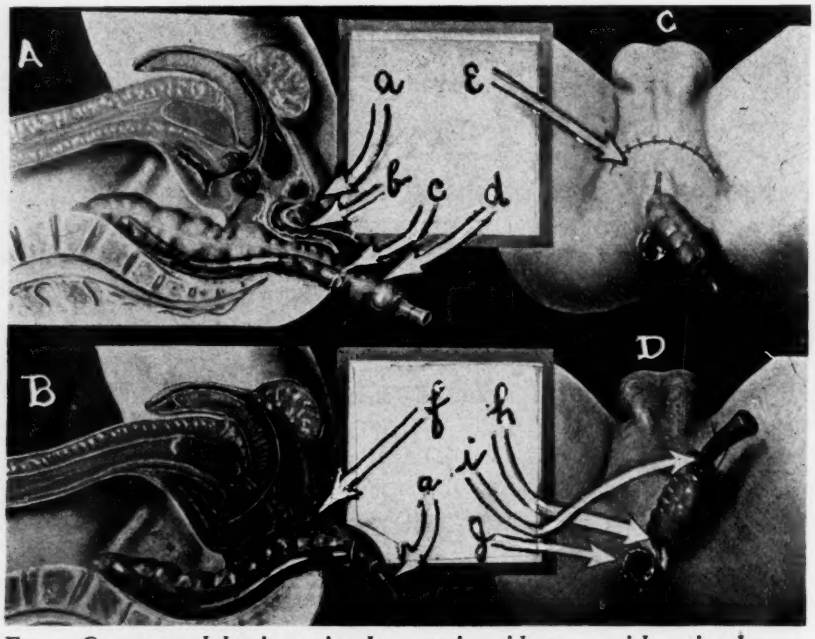


FIG. 7. One-stage abdominoperineal proctosigmoidectomy with perineal anus. A, the diseased loop of bowel has been liberated from above, then delivered through a median post-anal incision and removed. B, the perineum, pelvic floor and rectosigmoid have been removed after liberation from below. C, for an invading anterior proctosigmoid cancer the pelvic colon and infiltrated portion of the prostate have been delivered through an anterior perineal incision and removed. The sigmoid has been brought through the remaining anus which has been split anteriorly to relieve tension. D, the pelvic colon and sigmoid have been delivered and removed as in A, but the rectum has been amputated just above the sphincters, and the withdrawn sigmoid laid in the gutter formed by splitting the anus posteriorly. A glass pelvic drain is in place. *a*, anus; *b*, rectum; *c*, perforated glass drain; *d*, sigmoid; *e*, anterior perineal incision for anterior infiltrating cancers of the rectum; *f*, defect from excising pelvic floor by a wide elliptical incision; *h*, posterior split anus; *i*, rectal tube tied in sigmoid; *j*, posterior perforated glass tube drain extending along sacral curve.

hollow of the sacrum, dressings are applied and the bowel then cut away. A rectal tube is tied in the sigmoid end; a short glass tube with attached Penrose drain in the rectal end. The purse-string suture is then removed from the anus. The glass drain is withdrawn after twenty-four to forty-eight hours. On the seventh to tenth postoperative day the partitions between the sigmoid, rectum and anus are divided and the edges sutured, converting the three openings into one.

A desirable variation at the conclusion of the operation is to divide the asepticized rectum just above the sphincters and also is not sutured to the skin or anus. Several patients have been out of bed by the tenth and have left the hospital by the fourteenth day after the operation. We also have used this operation for diverticulitis where the sphincters have been damaged.

If the carcinoma has penetrated the anterior rectal wall, an anterior perineal incision curving forward between the ischial tuberosities may be used, and the recto-sigmoid delivered with any resected attached portions of vagina or of prostate or vesicles. (Fig. 7.) In this case the sigmoid is divided by cautery between clamps and pulled through the dilated and anterior

divided anal ring. If the perineal floor is involved the invaded portion is freely excised and removed with the attached an abdominal incision. This proved to be a satisfactory and not difficult procedure.

The perineal opening enables the early

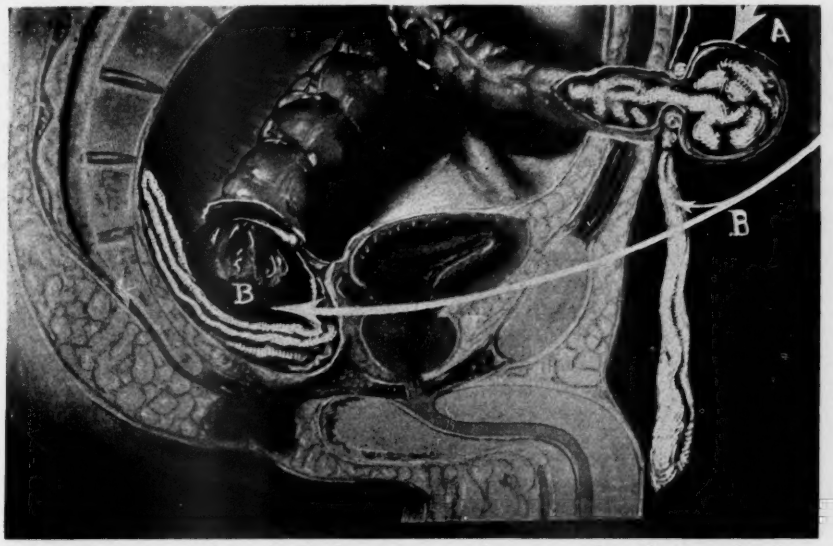


Fig. 8. Transfer of abdominal colostomy to perineum. A, the colostomy has been liberated and a cap of gauze and rubber has been tied over the end of the bowel with a folded gauze tape. B, the liberated bowel and traction tape placed against the floor of the pelvis for withdrawal through the perineum.

proctosigmoid. A retention catheter is inserted in the bladder before and not removed for several days after the operation. I have lost two patients from a hemorrhagic and necrotic cystitis following postoperative over-distention of the bladder.

In all cases posterior dependent drainage with curved perforated glass tubes carried through the perineum along the hollow of the sacrum should be used. Adequate drainage is the best prophylactic against spreading peritonitis in these cases. At first from using glass drainage tubes with an open end we had three patients in whom loops of small intestine entered and strangulated in the tube, with necrosis and secondary fistula in the perineum. The erosive discharge from these fistulas makes them very dangerous, as large blood vessels in the pelvis may be opened with fatal hemorrhage, as occurred in one case. Our experience has indicated that attempts to close such an intestinal opening through the perineum made matters worse and we would advise that the perforated loop be promptly liberated and closed through detection of a pelvic recurrence by palpation. In six patients a recurrent nodule was thus detected and excised at a relatively early stage. Three of these patients are now living without palpable recurrence, from two to over four years after the last operation. Without the diagnostic advantage of the perineal opening, such recurrences may reach an inoperable stage before recognition.

As with an abdominal colostomy, the comfort of the patient with the perineal opening depends largely upon determining and utilizing the storage function of the colon. If the patient regularly empties the colon just before its capacity has been reached, he will as a rule then have freedom from evacuation for from twenty-four to seventy-two hours, apparently much longer than with a colostomy. Most patients obtain the best results from a physiologic saline or tap water enema taken in the morning or evening every twenty-four to seventy-two hours. For the seventy-two hour schedule a low residue diet the day after the enema followed by a full diet the

day preceding the enema often works well. About 20 per cent of patients prefer a small dose of a quickly acting saline such as one or two teaspoonfuls of sodium sulfate taken in a little cold water immediately on arising. Soon after breakfast, which includes a cup of hot coffee, the colon empties, after which constipation follows for the two or three days it is found feasible to wait before repeating the laxative. Mineral oil or laxatives of delayed or prolonged action should not be used. The perineal orifice should be of adequate size. A narrow or strictured outlet prevents the rapid and complete emptying of the colon, and consequently small, frequent and annoying discharges from overflow result. This should be overcome by dilatation, the patient daily inserting test tubes or other dilators. Protrusion of the mucosa of the sigmoid may cause an unpleasant local moistness, easily corrected without anesthesia by linear galvanocauterization or the injection of a few minims of a 5 per cent solution of quinine and urethane. A perineal hernia apparently is less common than the hernia often seen about an abdominal colostomy. In two cases, however, we have operated for such a perineal protrusion.

Ileus is an important postoperative complication of resections of the proctosigmoid. Where a pelvic diaphragm has been formed the small intestine may herniate between the stitches or by tension the mobilized peritoneum may so angulate the terminal ileum as to cause obstruction. In either case the abdomen should be opened and the obstructed loop released. In the one-stage operation we have described, no pelvic diaphragm is formed and a loop of small intestine may adhere in the denuded pelvis and angulate. Like the ileus which occurs in the immediate postoperative period after operations for inflammatory conditions of the abdomen or pelvis or for large hernias we consider the best treatment to be a simple ileostomy. The most distended coil is localized by physical signs (distention and tympany) exposed by a short muscle-splitting incision and a No. 14 catheter with several perforations, tied in the loop. When the tension is released the obstruction usually disappears. If, on the other hand, the abdomen is freely opened and explored with separation of recent adhesions, these commonly soon readhere with return of the obstruction. Recent adhesions as a rule are too soft to produce necrosis of the strangulated loop. Quite different are the dense, well organized fibrous cords or bands, which produce an acute obstruction months or years after the abdominal operation which led to their development. The obstruction then often follows overeating or the use of laxatives and the great danger is from pressure necrosis, perforation and peritonitis.

Very recently a man, five years after a one-stage abdominoperineal proctosigmoidectomy with perineal anus, developed obstructive symptoms the night after heavy eating at a picnic. Three days later an emergency ileostomy was done and after an additional thirty-six hours, as this had not given relief, the abdomen was explored. Necrotic bowel which ruptured on delivery was found under a rigid fibrous cord in the pelvis. Such an experience is not very usual, and I would formulate a rule that an early postoperative ileus usually is best treated by a prompt enterostomy without separation of adhesions, while a late postoperative ileus indicates an immediate exploration and removal of the cause.

Elimination of the Abdominal Colostomy. An abdominal colostomy was transplanted to the perineum in seven patients. In four the colostomy had been a part of an abdominoperineal proctosigmoidectomy for cancer, in one patient eleven years, in another four years before. In the third patient the cancer had perforated the vagina and invaded the uterus and we had combined a panhysterectomy and resection of much of the vagina with an abdominoperineal proctosigmoidectomy and colostomy, seven months before. The

fourth patient had an en masse resection of uterus, appendages, upper vagina, rectosigmoid and 4 or 5 cm. of one ureter eleven

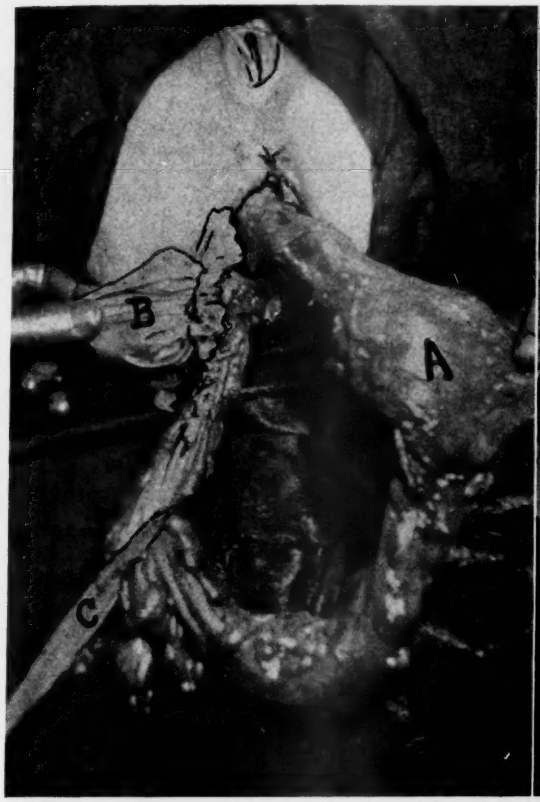


Fig. 9. Cancer of the rectosigmoid and attached double-barrelled colostomy of the sigmoid withdrawn in one stage through a post-anal incision after closing the abdominal wound. A, cancer. B, colostomy openings covered with gauze and rubber dam. C, traction tape fastened to B. The bowel was adherent and two previous attempts at removal through the abdomen had been abandoned. The patient strongly objected to the abdominal colostomy.

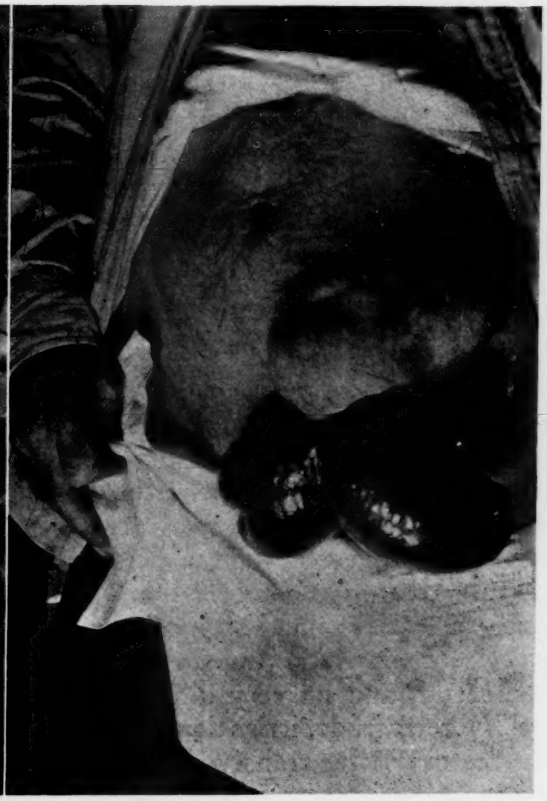


Fig. 10. Hernia and intestinal prolapse from colostomy eleven years after Miles operation for carcinoma of the rectosigmoid. The redundant bowel and scar were excised, the hernia repaired, and perineal anus formed.

months before the transplantation. The fifth patient had vertical very adherent abdominal scars from two previous attempts to remove a cancerous rectosigmoid. On account of adhesions the growth had been considered irremovable and a double-barrelled sigmoid colostomy was done. Without disconnecting the openings in the sigmoid, adhesions were divided and the recto-sigmoid and colostomy liberated from above and then delivered through the perineum with the formation of a perineal anus. (Fig. 9.) All five patients had satisfactory recoveries. The advantages of the perineal opening were very evident, such as ability to go without a pad or other protection, evacuations occurring every two to four days instead of several times daily, convenience for irrigation, diminished flatus, and more effective expulsive action of the abdominal muscles. The remaining two patients were cachectic men. One, aged 60 had been treated for over a year by injections. A sigmoid colostomy for an obstructing anorectal carcinoma was done twenty-four days before an abdominoperineal resection with transplantation of the colostomy to the perineum. Despite preoperative evacuant measures the colon contained much impacted fecal material. The advanced adherent carcinoma ruptured in delivery. The patient died of a postoperative peritonitis. The seventh patient, aged 70, had a recto-

sigmoid carcinoma. On account of his great debility a two-stage operation was tried, a double-barrelled sigmoid colostomy being done at the first stage, and a proctosigmoidectomy with delivery of the bowel and of the colostomy through the perineum at the second stage fifteen days later. The patient died later from a necrotic metastatic carcinoma of the lung.

These experiences have confirmed our impression that it is easier and safer to do a proctosigmoidectomy in one instead of several stages, that any preliminary colostomy should not be in the field of the radical operation, and that while a permanent palliative colostomy for cancer of the rectosigmoid may properly be placed in the sigmoid, a temporary colostomy for intestinal obstruction should be in the cecum or proximal colon. It also was evident that it is safer to reoperate in the field of an old rather than a recent colostomy. With chronic obstruction in the terminal bowel a bulky fecal impaction may extend back to the cecum and be very difficult to remove by retrograde irrigation through a sigmoidostomy. In transferring a colostomy to the perineum, if there is a double-barrelled opening, it is usually better to isolate and ligate the ends of the bowel as one, covering the openings with a single protection of gauze and rubber drain, securely ligated in place rather than to divide the bowel.

Technique of Transferring an Abdominal Colostomy to the Perineum. The colostomy opening is plugged with antiseptic gauze and closed with sutures, and when liberated, the end of the bowel is covered by a cap of gauze and rubber dam securely tied on with a long tape. (Fig. 8.) The sigmoid segment and if necessary the descending colon are then sufficiently mobilized from peritoneal and other attachments to slide at least 12 cm. (5 inches) below the posterior pelvic brim. The soft tissues in the midline close to the sacrum are divided and then tunneled to the pelvic floor until a channel is formed through which the sigmoid may easily be drawn. The tape is packed in this tunnel, the end of sigmoid laid over the opening and abdominal wound closed. With care not to injure the urethra or bladder the perineal scar is opened from below and the tape and attached sigmoid pulled through. A glass tube drain is introduced at the side of the coccyx or through the incision back of the sigmoid. A rectal tube is fastened in the sigmoid to prevent soiling during the first few days after the operation. The glass drain is usually removed in from twenty-four to forty-eight hours.

Operability and Mortality. Unfortunately, universal standards have not been adopted as to the operability of persons having cancer of large intestine. Personally I have attempted a radical operation in any case in which it offered a chance of prolonging the patient's life or rendering it more comfortable even though it could not be curative. Thus of about 265 patients seen during more recent years, operation was done in 252, which included removal of the cancerous segment in 212, an operability rate of 84 per cent, if we include patients not curable but relievable. In about 40 per cent of the patients symptoms indicative of cancer had been present over one year and in 21 per cent from two to even five years before the operation. At the time of operation 37 per cent of the patients were over 60 years of age, and 11 per cent between 70 and 79 years. As has been indicated, metastases were not uncommon in those considered to be radically operable. With such an exorably distressing and fatal disease as cancer the patient has little to lose, except pain, if given the benefit of every surgical doubt.

An enlarged lymph node in the field of the cancer is frequently found free from malignancy in the laboratory. Occasionally ominous physical signs, as fixation, the intense anemia of a cecal cancer, or a report from previous operation that the growth was adherent and irremovable, will be found due to a benign cause or to a malignancy that can be extirpated.

Mortality and our concepts of operability are closely related. Of the 252 patients forty-six, or 18 per cent, died after

operation while in the hospital. The highest mortality occurred in cases with perforation and resulting peritonitis, abscess or fistula: fifteen cases with nine deaths (60 per cent). Next was the mortality from direct anastomosis, nine deaths in twenty-six cases, almost entirely from resections of the functional left colon. While the mortality has been reduced by the recent use of better drainage, and while the operation is believed to be safer than a Mikulicz resection for the right colon, it has now been largely abandoned for the left side of the colon unless the fecal current has previously been diverted.

Colostomy—an operation under other circumstances of very low mortality—had a mortality of 30 per cent in the twenty-three advanced cases in which it was used as a palliative measure. The operation renders these patients disgusting to themselves and to their friends, who do not care to take them from the hospital and often leave them until they succumb to the progress of the disease. Our present tendency is to do very few so-called palliative colostomies. In the face of obstruction we depend upon a low residue diet, irrigations, and duodenal suction. For the patient whose advanced disease leaves him but few remaining days we think it better to let him die obstructed than to inflict the nuisance of a colostomy upon him and his attendants.

The operative mortality is much reduced if we eliminate those shown by autopsy or otherwise to have been hopelessly diseased by metastasis or those that we have learned by experience were inadequately drained at the time of operation. Then the mortality in our series from abdominoperineal proctosigmoidectomy with perineal anus drops from 20 per cent to under 6 per cent, from perineal proctectomy from 11 per cent to under 4 per cent, and from the Mikuliczé-Paul operation, from 15 per cent to about 5 per cent.

MULTIPLE POLYPOSIS: CONGENITAL, HEREDOFAMILIAL, MALIGNANT

DESCUM C. MCKENNEY, M.D.

BUFFALO, NEW YORK

POLYPS occur throughout the colon in various numbers and at all ages. As they, whether single or in numbers, are so often the origin of early malignancies, their importance is being more and more appreciated, hence early recognition and treatment of these growths, when benign, is good insurance against carcinoma.

Each word in "Multiple Polyposis" indicates plurality, and hence the caption is incorrect. Yet as it has been in use so long and is generally understood, I shall continue to employ it. Other terms such as adenomatosis, disseminated adenomata or polyposis, polypoidosis, agminated adenomata, polyposis intestini, multiple adenomata, colitis polyposa, and polypoid disease, appear in the literature. So many are confusing. Buie's designation of the disease, when more than one polyp is present, as multiple polypoid disease—to which he attaches the name of the anatomic portion of the colon involved—is no doubt more appropriate.

CLASSIFICATION

The definition of a polyp implies that it is a pedunculated growth or tumor, but from usage now includes the sessile variety as well. Polyps in the colon are both pedunculated and sessile. In this paper multiple polyps only will be considered. Although perfect classification seems difficult, Erdman and Morris[2] have given us the one that has been, perhaps, most commonly employed in papers on the subject, viz., (1) the adult or acquired type; (2) the adolescent (congenital or disseminated type).

The adult or acquired type is assumed to occur only in adults and be due to some form of irritation. Yet we have all seen multiple polyps in the infant, child or youth and felt certain they were not congenital. No doubt they also were acquired.

This type is the result of inflammation and is found most frequently with the different varieties of ulcerative colitis. Repeated clinical observations of colitis cases will easily demonstrate the truth of this statement, as the formation and growth of polyps can readily be followed through the sigmoidoscope.

The adolescent type, so far as the colon is concerned, is disseminated, heredofamilial and, I believe, congenital, continuing into adult life if the individual does not succumb to malignancy before then. I will consider multiple polyposis of the adolescent, congenital or disseminated type only.

A previous report of two family groups with multiple polyposis (referred to as Groups A and B) was made in May, 1936, before the Gastroenterological Section of the American Medical Association at the Kansas City Meeting.[5] These Groups, A and B, will be so designated in this paper also.

We attempted, when a case of polyposis was discovered, to contact and examine all other living members of each family group, whether with or without symptoms, and also to examine the records of those who had died. Some refused and still refuse examination and the survey is therefore not complete. No new cases are added.

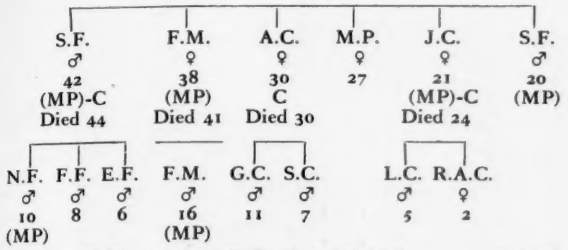
The details of the findings in these two groups are given in Tables I to IV.

Recent correspondence would indicate that the health of four children of Group B (L. H., D. E., B. B., and L. B.) is not good and their complaints are not unlike those

TABLE I*

INCIDENCE OF MULTIPLE POLYPOSIS AND CARCINOMA IN FAMILY GROUP A

Group A: N. F.-♂; 47; ???; Died 47



Key to Tables I and III: S. F. ♂ or ♀, initials, sex; 42, patient's age at examination or on records; (MP)-C, multiple polyposis and carcinoma; Died 44, age at death; (MP), multiple polyposis; ?, needs watching; ???, history; M.P.?, Carc.? or both?

* After McKenney, in *J. A. M. A.*, 107: 1871, 1936.

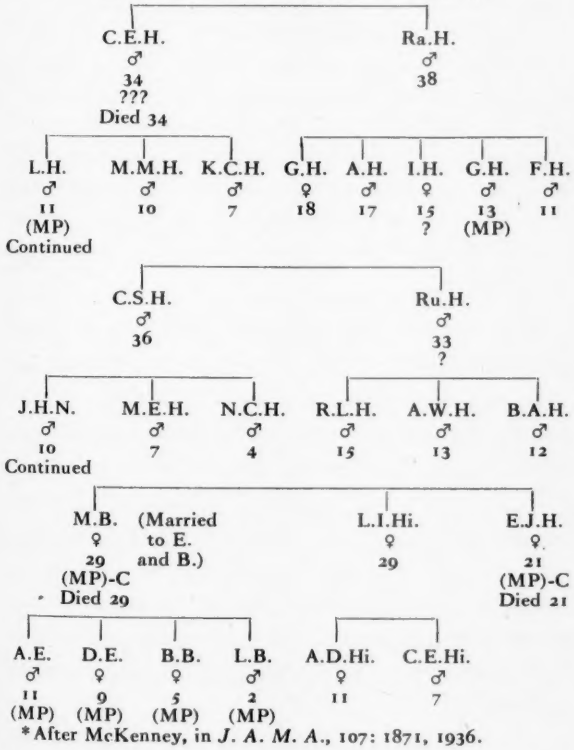
TABLE II

GROUP A

Members family group studied....	15
Found to have multiple polyposis..	6 (40 per cent)
M.P. cases died of carcinoma.....	2 (33⅓ per cent)
Clinical diagnosis carcinoma (not counted).....	1

TABLE III*

Group B: A.C.H.-♂; 44; (MP)-C; Died 44



* After McKenney, in *J. A. M. A.*, 107: 1871, 1936.

TABLE IV

GROUP B

Members family group studied...	28
Found to have multiple polyposis.	9 (32.14 per cent)
M.P. cases died of carcinoma.....	3 (33⅓ per cent)

of A. E., the brother of the last three mentioned, who died recently. The brief record of this case which I shall give, is a rather typical picture of the course of the disease, only too often seen in the young person.

A. E., a white male, age 11 (one of the four children of M. B., Group B, Table III) was examined October 30, 1932. He had a history of three to five bowel movements daily for the past seven years; bright red blood with stools for two months; occasional pain in the right upper quadrant.

Examination showed a well developed, well nourished boy, not acutely ill. The abdomen was soft and not tender. Four plus blood was noted in stools. Eosinophilia was 8 per cent. Sigmoidoscopic examination revealed many polyps, 1 to 8 mm. in diameter, in the lower 10 inches of bowel, closely segregated about the colorectal junction.

Treatment. From November 2 to 5, 1932, the boy was given 300 Roentgens, but no change was noted following this therapy.

Examination on April 28, 1934 was essentially the same as in 1932. *X*-ray showed numerous polyps from the hepatic flexure to the rectum. Stools were negative for blood. (Fig. 1.) Biopsy of one of the polyps showed benign adenomatous proliferation. Treatment: 600 Roentgens over the anterior abdomen. On May 28, 1934, diarrhea and frequent emesis were reported. The patient was in bed part of the time.

July 29, 1934, he was apparently well. Sigmoidoscopy showed little difference in the polyps. Treatment of 600 Roentgens over the anterior and posterior abdomen was given. August 8, 1934, sigmoidoscopic examination showed the polyps very red, bleeding easily, with considerable mucus.

November 11, 1934, 600 Roentgens were administered. Biopsy showed "adenomatous proliferation well on the way to being malignant." The child was still well developed, however, and growing steadily.

By July 29, 1935, no untoward symptoms had developed, the bowels were regular with no blood or mucus. A further treatment of 600 Roentgens was given and biopsy showed "premalignant changes."

In April, 1936, I had a letter from his guardian which stated that the child attended school

regularly, had gained 11 pounds in seven months; had one to two stools daily with no blood or mucus. His appetite was good. Later in

Fig. 1. A. E., male, age 11, showing characteristic mottling of multiple polyposis throughout the whole colon.

the month another letter stated that there was "difficulty in voiding; progressive swelling across the lower abdomen with considerable pain." The symptoms became worse and swelling increased. In August, the boy went to bed and remained there. Swelling broke through the lower abdominal wall in September and thereafter all bowel passages were through this opening. The urinary symptoms ceased but the patient rapidly became emaciated.

In October, 1936 I saw him, emaciated and failing rapidly, with small bowel passages and urine pouring from a wound in the abdomen. He expired November 11, 1936.

Autopsy. There was an opening 1 inch in diameter through the abdominal wall above the pubis, slightly to the left of the median line, through which fluid fecal contents and urine poured. A large abscess cavity occupied the entire pelvis, extending up over the posterior, superior and anterior walls of the bladder, opening through the hiatus mentioned. The small bowel formed part of the abscess wall and had perforated into the abscess cavity, as had the bladder. Below the rectal perforation the rectal mucosa was studded with many polyps, from 2 to 8 mm. in size. The heart and lungs were apparently normal; few enlarged lymph nodes were observed in the mesentery; liver, spleen, pancreas and kidneys showed nothing remarkable.

Although the *x*-ray in April, 1934 had shown polyps from the hepatic flexure downward, few were seen at autopsy proximal to the

Fig. 2. F. S., male, age 35, showing mottling of multiple polyposis.

splenic flexure, but they were present from the splenic flexure to the rectal perforation, which might indicate slight benefit from the *x*-ray.

Sections taken from near the perforation in the rectum and examined by Dr. W. F. Jacobs showed necrosing carcinoma. Sections bisecting the bulbous tip and pedicle were made through each of eight polyps taken from above and below the carcinoma. In none was there any invasion of the pedicle or mucosa and the gland proliferation was definitely papillary adenoma.

The story of multiple polyposis, congenital type, is one of catastrophic events. A young mother, dying a horrible death from the disease with carcinoma, gives birth to a child in all probability doomed to a similar early fate. Young children, while seeming to be in fair health, suddenly sicken and suffer intensely a shortened life, to plunge into the agonizing death stage of carcinoma, short in point of time, but seemingly long because of the intense suffering.

A polyposis family group history is an ever changing one and the chronicler must not lay aside his typewriter, as the story must constantly be rewritten. The surgeon in charge of such a family has plenty of worries, knowing his limitations

in affording help because of: (1) the difficulty in getting coöperation from these patients; and (2) the difficulty of rendering services productive of results desirable and satisfactory to both the patient and physician.

Fig. 3. F. S. Histology of typical polyp.

Fig. 4. F. S. Histology of typical polyp right; undergoing malignant change left.

I wish now to add another family group, referred to as Group C, to groups A and B.

GROUP C

In May, 1925, before the American Proctologic Society in Atlantic City,[4] I reported a single case of polyposis the nucleus of Group C (Table v), of which the following is a brief summary:

A male, F. S., aged 35, presented himself for examination in September, 1924, stating that for ten years he had never had a formed stool. Instead, he had up to fifteen fecal-stained fluid stools a day without blood, mucus or unusual amount of gas. More recently he had developed cramps and was unable to work.

On examination polyps were easily palpated in the lower rectum, many were demonstrated with the sigmoidoscope in the lower 12 inches and by roentgenography (Fig. 2) throughout the colon.

Through the sigmoidoscope 600 of the tumors were removed and when two large ones at the colorectal junction were destroyed his cramps disappeared and he was able to resume his work.

Later he developed carcinoma in the lower pelvic colon (Figs. 3 and 4), followed by obstructive symptoms necessitating a colostomy August 19, 1928. He died October 7, 1929, of pelvic peritonitis due to perforation through the carcinoma.

Autopsy revealed carcinoma of the lower pelvic colon with perforation, suppurative peritonitis and adhesions, polyposis of the entire colon, except the rectum where polpys had been removed and only occasional small ones were seen. The polyps were from pinhead to plum size, pedunculated and sessile, closely set everywhere throughout the colon. Bronchopneumonia with beginning suppuration (Fig. 5) was also noted.

Fig. 5. F. S. Polyps of various sizes, sessile and pedunculated, throughout whole colon. A, carcinoma upper rectum. B, perforation through carcinoma which caused pelvic peritonitis. C, colostomy opening. D, practical freedom from polyps in lower rectum from which 600 had been removed.

At this time every effort was made to get permission to examine the patient's child, his brothers and their children, but with no success at that time.

Fig. 6. L. C. V., female, age 22, showing the mottling of multiple polyposis through entire colon and a large polyp in the proximal transverse colon which caused an intussusception.

Eight years later, July 10, 1937, Mrs. L. C. V., age 22, (niece of F. S., who had died eight years previously) (Table v) presented herself with a history of good health up to the previous two years when she began to have eight to ten stools during the day and two or three at night. This had become worse in the previous three months, with much blood, pain in the lumbar region and right lower quadrant. She had lost 12 pounds in weight.

Examination revealed an adenocarcinoma running upward from the junction of the upper and middle thirds of the rectum, involving the anterior wall and sides. The polyps, sessile and pedunculated, were seen through the sigmoidoscope in the lower 10 inches of the bowel and demonstrated by roentgenography throughout the entire colon, with a cluster of polyps, or carcinoma, in the proximal third of the transverse colon. (Fig. 6.)

An appendectomy had been done in 1934.

The question arose, what to do with this girl. In consultation with Dr. T. E. Jones[3] of Cleveland, we agreed that as she was so young, the chances were that metastases had already taken place and that surgery would be of no avail. Besides, if surgery were resorted to and, despite it, the patient died, it might discourage treatment of the other members of the family, who, as I will show later, had the disease.

In September, abdominal pains obstructive in character developed and continued to get worse. Roentgen ray again showed in the transverse colon a tumor which had previously been palpated.

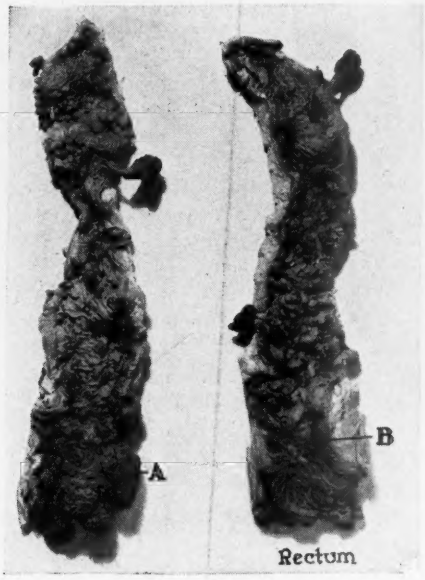


Fig. 7. L. C. V., polyps, various sizes, sessile and pedunculated. A, large polyp in proximal part transverse colon. B, carcinoma of rectum.

The patient refused operation until November 16, 1937, when pain became unbearable. Through a median lower abdominal incision the mass, as large as a lemon, was located in the transverse colon where it had caused an intussusception of the first part of the transverse colon into the middle third. (Figs. 6 and 7.) This was reduced without difficulty. A loop bearing the polyp was then easily brought out through the upper part of the wound and left outside the abdominal wall to be opened proximal to the polyp the next day. Unfortunately, the patient died a few days later of peritonitis.

An autopsy limited to the abdomen revealed multiple polyposis of colon, with few polyps in the rectum and with many apparently infarcted polyps, sessile, slightly ulcerative carcinoma in the upper part of rectum, large papillomatous polyp of the transverse colon at the site of colostomy opening, and diffuse, fibropurulent peritonitis. (Fig. 7.)

Figure 8 shows the histologic findings in a typical polyp. Figure 9, taken from the large polyp seen in Figure 7, shows atypical histo-

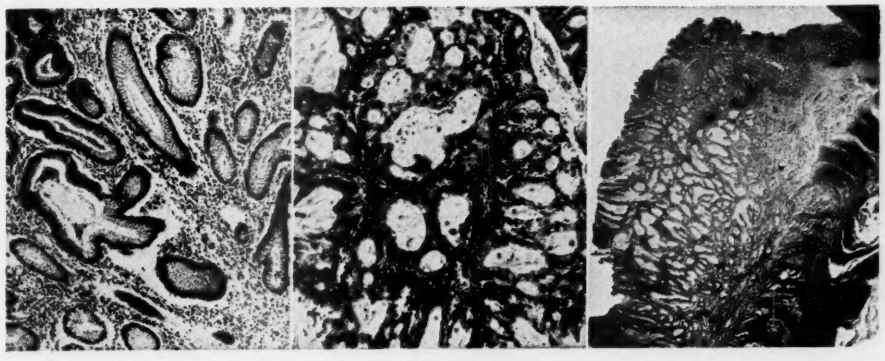


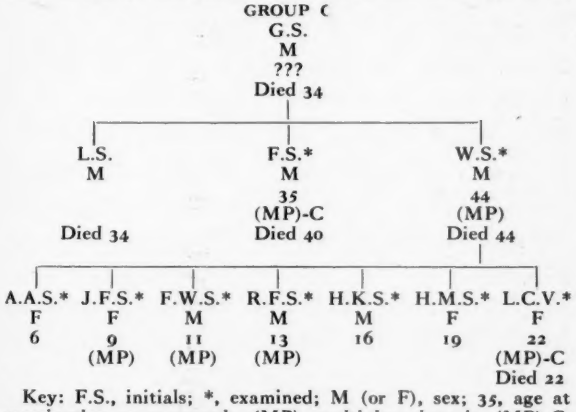
Fig. 8. Fig. 9. Fig. 10.

Fig. 8. Histologic findings in typical polyp.
Fig. 9. Atypical histologic findings in papilloma with marked glandular proliferation, hyperchromatic nuclei and mitotic figures (from Fig. 7A).
Fig. 10. Adenocarcinoma invading submucosa and muscularis (from Fig. 7B).

logic findings in papilloma with marked glandular proliferation, hyperchromatic nuclei, and mitotic figures. Figure 10, taken from the rectal tumor, shows an adenocarcinomatous invasion of the submucosa and muscularis.

Table v

Incidence of multiple polyposis and carcinoma in group C



Key: F.S., initials; *, examined; M (or F), sex; 35, age at examination or on records; (MP), multiple polyposis; (MP)-C, M.P. and carcinoma; ???, history suggests M.P., carc. or both; Died 44, age at death.

G. S., grandfather of the previous patient, died at the age of 34. (Table v.)

From a very meager hospital record and from relatives I obtained the following history: He fell out of a hay barn on a machine handle and six months later developed a diarrhea with blood in the stools and vomiting. Following this (how long I could not learn) he had two operations in a hospital, dying twenty days later with fecal vomiting. It is evident his trouble was intestinal; he died young; and two of his sons, as I will show later, had polyposis. These are three bits of incriminating evidence that his trouble was polyposis, or polyposis and carcinoma, rather than some trouble from the accident which had occurred six months before. There was no history of symptoms in the meantime which could be attributed to the accident.

G. S's wife is still alive, has no symptoms that might make one think of polyposis, but will not submit to examination.

G. S. had three sons. One, L. S., is said to have died of pneumonia at the age of 34. F. S. died of multiple polyposis and carcinoma. W. S. had multiple polyposis and died of a heart condition just recently. The latter had ten children, of whom three died in infancy and three more, so far as I know, are free from the disease. One of these may have it, as the examination in this case was very unsatisfactory. The oldest child, L. C. V., died of multiple polyposis and carcinoma, and three others, a girl aged 9, one boy aged 11, and another aged 13, all have polyposis and at the time of the examination in July, 1937 seemed quite well, except that each had two or more stools a day. Since then they have consistently refused examination. L. C. V. had no children. (See Tables v and vi.)

TABLE VI

CLINICAL HISTORIES IN GROUP C

66⅔ per cent multiple polyposis
33⅓ per cent of the multiple polyposis cases died of carcinoma

Members of the family group	9
Examined	9
Multiple polyposis	6
Ages when examined: 9, 11, 13, 22, 35, 44	
Average age	23.16
Males	4
Females	2
Of these 6 multiple polyposis cases:	
Died of carcinoma, ages 22, 40	2
Died, heart condition?: age 44	1
Alive, ages: 9, 11, 13	3

The three family groups are combined in Table VII. Fifty-two people were studied and 40.39 per cent of these were found to have polyposis; 38.09 per cent of these are now dead of carcinoma. (Table VII.)

TABLE VII

SUMMARY OF THREE FAMILY GROUPS (A, B AND C)

40.39 per cent had multiple polyposis
38.09 per cent of the multiple polyposis cases died of carcinoma

Members of the three family groups	52
Examined	47
Dead, records studied	4
Dead, history from family	1
Multiple polyposis	21
Ages: 2, 5, 9, 9, 10, 11, 11, 11, 13, 13, 16, 20, 21, 21, 22, 29, 38, 40, 42, 44, 44	
Average age	20.52
Males	13
Females	8
Of these 21 multiple polyposis cases:	
Died of carcinoma, ages: 15, 21, 22, 24, 29, 40, 44, 44	8
Died, suspected carcinoma, age 41	1
Alive, ages: 2, 5, 9, 9, 10, 11, 11, 11, 13, 13, 16, 20	12

TABLE VIII

AGE INCIDENCE OF GROUPS A, B AND C MULTIPLE POLYPOSIS, ADOLESCENT TYPE

Decades	Cases	Ages
1–10	5	2, 5, 9, 9, 10
10–20	7	11, 11, 11, 13, 13, 16, 20
20–30	4	21, 21, 22, 29
30–40	2	38, 40
40–50	3	42, 44, 44
Total	21	
Youngest	..	2
Oldest	..	44
Average	..	20.52

As examination was made of all members of a known polyposis family where permission to do so could be obtained, this table shows the disease present as one might expect in an exceptionally large percentage of young persons. Fifteen of the twenty-one were from 2 to 22 years of age.

CONGENITAL, HEREDITARY, FAMILIAL

My contention that the disease is congenital in origin is based on the following observation:

The study of four children in the same family, Group B, each with multiple polyposis, seems to bear out well the congenital theory. These children were respectively 2, 5, 9, and 11 years of age. The difference in the ages of these four children is approximately two and three-fourths years. The amount of increase in size of the adenomas of the oldest child over the next younger and of the latter over the next younger and so on down to the youngest is practically alike for each two and three-fourth years period. This, to me, would indicate that the youngest child, from the size of the growths found at the time of the first successful examination (age 2 years), had been born with the growths. Examination of the youngest child, L. B., when 1½ years of age, could not, because of resistance and lack of preparation, be accomplished with any degree of satisfaction, but six months later the polyps were easily found. (Fig. 11.)

A similar observation in Group C seems to point toward the congenital origin. Four children in this group, although not so young, were respectively 9, 11, 13, and 22. The size of the polyps of the 22 year old was at least four times that of the 13 year old, although one polyp had grown many times larger. The amount of increase in the size of the polyps of the 13 year old over the 11 year old apparently equaled that of the 11 year old over the 9 year old.

Also of interest is the fact that the size of the polyps in the 9 year old child in each of two groups (B and C) was practically the same. This is also true of the 11 year old children in each of the same two groups.

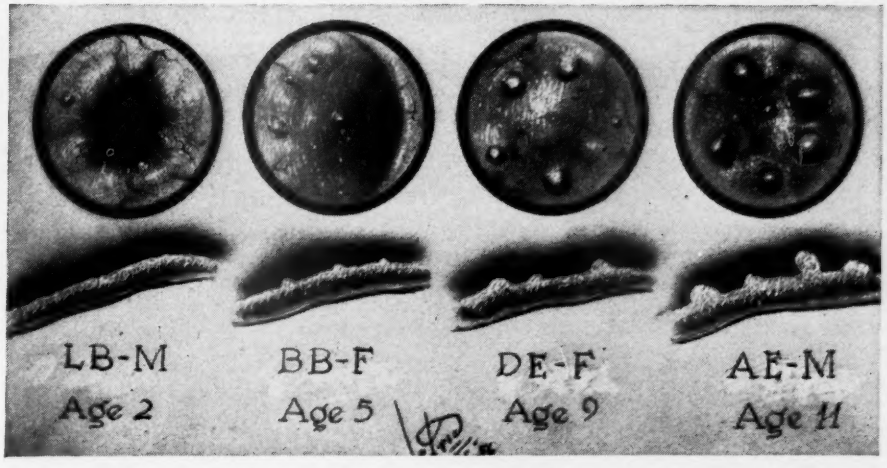


FIG. 11. Comparative size of adenomas in four children of one family, ages 2, 5, 9 and 11. As there is an average difference of two and three-fourths years in the ages and so nearly a like amount of growth for each period, it suggests congenital origin in the 2-year-old and hence in all. (From McKenney in *J. A. M. A.*, 107: 1871, 1936.)

Only the examination of newly born children in known polyposis families will clear up this question. In infants, by following the technique outlined in the chapter on diagnosis, we can expect to find, not well formed polyps, but immature ones no more than a millimeter in diameter, showing just below the surface if they are present. Polyps such as these may also be found among larger polyps in older children, if carefully looked for.

That the disease is hereditary and familial is very evident. The transmission is through either sex. In group B (Table III) it was passed from father to daughter and, through her, to one son and one daughter by one husband and to another son and daughter by a second husband. All or only part of the children of one afflicted parent may have the disease. In group B it missed one generation to appear in the next.

So far, I have been able to trace the disease through three generations only. (TABLE III).

MALIGNANT TENDENCY

It has been my experience that pathologists find in many cases, where many polyps from one patient have been examined, changes so suggestive of beginning malignancy that they hesitate to call all the polyps benign and advise constant watching. Their caution is well-founded considering the malignant change seen in my series.

Of twenty-one multiple polyposis cases in my three-family series eight are dead of carcinoma, i.e., a percentage of 38.09. Figures from various sources place the percentage at about 50. My feeling is that eventually malignant change will take place in every case.

Two others with polyposis have died, the one aged 41 with strong suspicion of carcinoma; the other, aged 44, is said to have died a cardiorenal death, although the pathologist some time previously reported "a very fast growing polyp." Neither case is included in the above figures.

My study of multiple polyposis began in September, 1924 with one case, and no more were seen until 1930. The one seen in 1924 and one other (from reliable records) had died just before 1930, while six more died in the nine-year period

after 1930, i.e., eight deaths from carcinoma in about ten years. The ages of the eight were 15, 21, 22, 24, 29, 40, 44, 44, an average of 29.87, while the average age of the eleven still living on June 1, 1939 is 16.82. Thirteen years from now the average age of the eleven living will be the same as that of the eight dead. Is it not reasonable to assume that the eleven will be dead in that length of time if nothing is done in the meantime to prevent it?

Buie says: "In at least half of these cases in which total polypoid disease of the colon is found, tissue can be obtained which will give evidence of adenocarcinomatous changes on microscopic examination." He also states: "So definite is the progress of histologic metamorphosis in all polyps of the colon that, given sufficient time, it is believed that all polypoid lesions of the colon, although not actually classified as malignant growths, should be treated as such and whenever possible destroyed promptly on their discovery."

In the examination of polyps no matter how many are returned as benign, the next may be cancerous. A negative report is of value in regard to the single polyp only. The chance of finding a malignant polyp for biopsy is greatly enhanced if one sees sudden rapid growth in a polyp that has been under observation. Carcinomatous degeneration of polyps is always very malignant and rapidly fatal, a factor in which, no doubt, the youth of the patient plays an important part.

The frequency of malignant change in multiple polyposis can only be correctly estimated when every member of a generation and at least two succeeding generations is examined, careful records kept and autopsies done on all who die, unless clinical and histologic study positively established a diagnosis of carcinoma before death. To accomplish this one surgeon should pass on his records to a younger successor, who by carrying on in the same manner will, after a few generations have expired, be able to give authentic information.

Of course an examination and an autopsy on every one that dies cannot be hoped for.

I know of no one in my group that has passed the age of 44 with polyposis, so study over about a fifty-year period should be sufficient.

SYMPTOMS

In some cases, discovered in the adult, a history of two to even ten loose bowel movements a day without cramps, blood or mucus in the stools or other untoward symptoms, has existed for a number of years without any apparent impairment of health. In more instances, however, the adult presents himself with the severe symptoms of advanced polyposis or malignancy and a history of impaired health for some years.

In a child up to 6 to 8 years of age there may be no demonstrable symptoms other than perhaps one or two extra bowel movements a day. From this time on, up to about the age of 14, indefinite abdominal pains usually occur at irregular intervals. Slight increase in the stool frequency, with at first an occasional showing of blood in the stools, may also be noticed.

It is plain so far as symptoms are concerned, that, except for slightly increased bowel frequency, the disease can go unheralded during the early development of the polyps, longer in some cases than in others.

Later, increase in the number of stools, with blood and mucus, cramp-like abdominal pains, and tenesmus were found to be due to a large polyp, or the segregation of polyps at the normally narrow part of the colon, the colorectal junction, causing progressive obstruction with increased secretion of mucus. Intussusception is very likely to occur. Similar symptoms were caused, but less frequently, when the rectal polyps were large enough to exert more or less constant pressure on the push-button of defecation, the anorectal junction. This also occurred if they were large

enough to secrete quantities of mucus, which had the same effect when flooding and irritating the same push-button.

As malignancy occurs early in this disease, severe diarrhea with tenesmus, the passage of very frequent stools with much blood, mucus and gas, with marked anemia and emaciation, may be expected and looked for to indicate such a change. One of the youngest of my cases to develop carcinoma was A. E., who died at the age of 15.

Although blood in the stool occurs sooner or later, it may not be noticed for some time. It indicates injury to the polyps by the passage of stool, inflammation or malignant change. The bleeding may be from slight to profuse.

As observed by Buie, these symptoms are less pronounced when the polyps in the pelvic colon and rectum are removed. Especially is this true when the polyps are near the colorectal or anorectal junction. One of my cases, F. S., a male, who had been practically bedridden was, after such treatment (particularly the removal of two fairly large polyps from the proximal side of the colorectal junction), able to return to work and continue until he developed a carcinoma. (Fig. 5.)

DIAGNOSIS

There may be a history, early in the disease and for some years, of a slightly increased bowel frequency with loose stools, but no apparent morbidity resulting therefrom. This is followed later by recurring attacks of diarrhea, with blood, mucus, gas, cramps, and anemia; still later, when malignancy is superimposed, all these symptoms are greatly exaggerated. Although these symptoms are not characteristic of this disease alone, if one is aware that his patient comes from a polyposis family they become most suggestive.

The polyps can frequently be palpated digitally and, when large enough, some of the polypoid and sessile types may be distinguished. However, in the young individual, under 6 years of age, on account of the small size of the polyps, this is practically impossible.

The routine use of the sigmoidoscope, as advocated by proctologists, has made diagnosis possible at a much earlier age. The instrument opens to direct inspection with perfect illumination the distal 25 to 30 cm. of the bowel. With the lamp at one side of the distal end of the instrument, light is thrown across the field so that the tiniest polyp will cast a shadow, bringing it into relief and making it visible. A light thrown downward on top of the polyp, as from a lamp in the proximal end of the instrument, would cast no shadow and the growth might, perhaps, be missed.

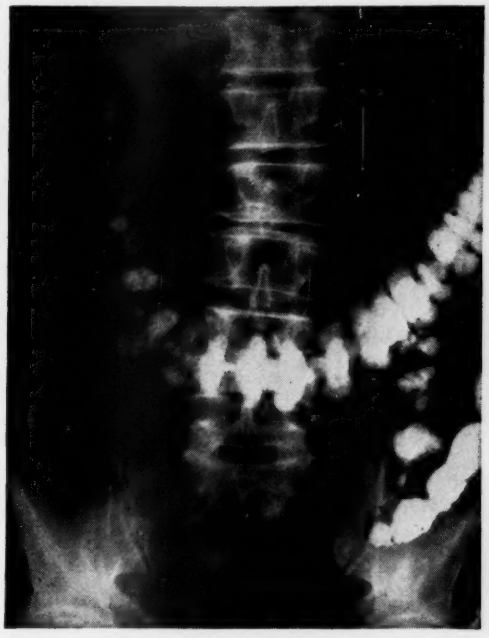


Fig. 12. Film of colon containing bran and simulating polyposis.

Roentgenographic examination by double contrast media, barium followed by air injection, after the method of Fischer, modified by Weber,[6] defines the extent of the involvement, which in the case of the congenital type is practically always through the whole colon. A pathognomonic mottling establishes the diagnosis. It is well to bear in mind that this mottling may be simulated and puzzling to the inexperienced when bran has been eaten

and the bowel not thoroughly emptied. A cathartic will clear up the suspicion. (Fig. 12.)

The region of the lower pelvic colon is now no longer "no man's land" so far as diagnosis is concerned as it can be doubly examined by means of the sigmoidoscope from below and by improved roentgenographic technique.

All of my cases were diagnosed easily with the sigmoidoscope alone. The *x*-ray demonstrated the extent.

Occasionally a large polyp causes an intussusception and obstruction, with characteristic symptoms, especially if near a narrow part of the bowel such as the hepatic or splenic flexures or the colorectal junction. In such cases a tumor may be found on abdominal palpation. There may also be abdominal distention and vomiting. (Figs. 6 and 7.)

Diagnosis of this disease, to be of greatest value, should really be multiple, by which I mean that when one case is found the study should extend to other members of the family and to as many generations as possible. Because of the occurrence of carcinoma in polyposis cases at such early ages, special attention should be paid to the search for polyposis in all young persons found to have rectal carcinoma, especially those with family cancer history. With this clue many more polyposis families might be located. Should the carcinoma be low in the rectum the polyps may be obliterated by the growth and be difficult to find, in which case the sigmoidoscope should be carried above the tumor. Should it be necessary to do a colostomy, through this opening and with the same instrument, internal inspection can easily be made upward and downward in the colon. If the malignancy is fatal then an autopsy will clear up the diagnosis.

Diagnosis in most cases is not made until the patient is in the late stages of the disease, whereas it should be made earlier if we are to get anywhere in the treatment. The only way the diagnosis of many young persons with the disease can be made is to examine all entitled to have it through heredity before symptoms compel them to seek medical advice.

DIFFERENTIAL DIAGNOSIS

Multiple polyposis of the congenital type has chiefly to be differentiated from the adult type, sometimes spoken of as "pseudopolyposis." In the latter, in my experience, the polyps have been rather few in number, irregularly distributed, and irregularly shaped, both sessile and pedunculated, with a tendency to be in clusters where ulceration was deepest and most extensive. A history of colitis and a finding of a shortened colon, a narrowed lumen, lack of haustration and active or healed ulcers in an adult should justify the diagnosis of this type.

TREATMENT

In my series, the youngest patient to die of carcinoma was A. E., aged 15 years, while the others died at ages 21, 22, 24, 29, 40, 44, and 44. It will be noticed that four were 24 or under. The average age of the eight who died was about 30 years. As it is impossible to anticipate the date of change from benignancy to malignancy, and, as carcinoma of the colon in the young person from its inception progresses very rapidly, any treatment to be successful must be employed early.

After diagnosis is made in young persons who apparently have no very annoying or untoward symptoms, it is difficult to convince them or their guardians of the seriousness of the disease and the necessity of treatment. Their decision is usually to leave well enough alone. Especially is this true if some member of the family, so afflicted, came too late for help and died while under treatment for alleviation of terminal suffering. This is regarded by the relatives as absolute failure of treatment, as is also radical treatment, should death follow it.

If these patients live to young adult life they have been accustomed to a certain amount of suffering for some time

and usually seek aid only when the severe symptoms of malignancy supervene.

In my series of cases the economic status of the patients stood in the way of treatment, but, even when this could be overcome, attempts at persuasion of the guardians to have a young person submit to operation, failed.

Three of the eight who died presented themselves with well advanced carcinoma, so that surgery was contraindicated. Another with carcinoma became pregnant and refused surgery for fear of aborting. She gave birth to a living child and died soon thereafter. Another developed a carcinoma, but refused surgery until obstruction made colostomy an emergency operation. Two died just before my study began. One aged 15, died on a farm a long way from Buffalo.

The high mortality from malignant degeneration warrants radical procedures in treatment.

To date the most successful treatment has been excision of the whole or a portion of the colon, and this, of course, should, if possible, precede malignant change. Such an operation is a formidable one and the danger of it, together with the dread of an ileostomy for the rest of life, is not a pleasant outlook for the patient.

In 1926, Dr. T. E. Jones[3] reported treatment of a female, aged 25, with congenital adenomatosis. He did a cecostomy, fulgurated the polypi in the rectum and sigmoid, following this by an ileosigmoidostomy and six weeks later a colectomy. Later the patient developed an adenocarcinoma in the retroperitoneal glands. His comment is "the moral of this case, of course, is to perform the colectomy earlier, as we lost about three years valuable time." He advises removing the polypi under spinal anesthesia in one or two sittings and performing the same operation as in this case as soon as possible.

From the patient's viewpoint the operation as performed by Jones, as it retains normal bowel control, is most desirable. The polyps of the rectum and pelvic colon to the highest point reachable through a sigmoidoscope are destroyed by snare or fulguration. Then an anastomosis of the distal ileum is made with the highest point of the cleared area in the pelvic colon. This is followed by excision of the rest of the colon. An objection to this over complete colectomy is the possible development of carcinoma in the portion of the large bowel below the anastomosis, where normally the highest percentage of carcinomas occur.

Removal of polyps by fulguration seems to dispose of them very satisfactorily and I do not recall the recurrence of one that had been completely removed. However, there may be some new ones develop, for which reason, after the operation mentioned, the bowel up to the anastomosis should be watched carefully and kept clean by further fulguration as necessary.

If a colostomy is made on the left side, in the iliac colon or the upper part of the pelvic colon, through a sigmoidoscope passed downward through this opening polyps can be removed to the highest point to which it was possible to clear the gut from below upward. This makes it possible to make the ileocolostomy at a higher point in the large bowel. An objection to this is that, after anastomosis is made, and the colostomy opening (the inspection window) has been closed, it is impossible thereafter to observe and keep free from polyps (potentially malignant foci) that portion of the large bowel above the highest point that was cleared of polyps from below upward. Of course, should malignancy develop and, by symptoms and *x*-ray, be discovered in time, this portion of the large bowel can then be removed and a permanent ileostomy done.

A word of warning in the use of fulguration is desirable. Fulguration can, with the patient in the inverted position, be carried out through the sigmoidoscope in one's office without an anesthetic. This position permits the air to rush in

and distend the bowel, making visibility as nearly perfect as possible, providing the bowel has been completely emptied of fecal contents in advance. In this way only can be exercised the care necessary to prevent perforation of the bowel at such vulnerable points as above the colorectal junction, opposite the cul-de-sac, or opposite the prostate or bladder. Before attempting fulguration in a case of this kind, the surgeon should have mastered the technique and acquainted himself with all the dangers associated with the misuse of such a powerful machine.

The sigmoidoscope can be made of bakelite or some nonconducting material, although that is unnecessary if the electrode is well insulated throughout its length, except for the active tip.

One of the greatest means of insurance against danger is to have the field kept constantly free from smoke. To that end I have constructed a sigmoidoscope with a built in smoke-suction tube, which is connected with a suction pump and functions while fulguration is in progress. Of equal importance is to have attached to the same suction pump by means of rubber tubing a suction pathfinder, a tubular instrument with piston grip and a ball at the distal end, which can be used for the double purpose of guiding the passage of the sigmoidoscope and of keeping the bowel free from fluids.

Should one fear that he has injured the bowel, the patient should be kept where a laparotomy can be quickly done if perforation occurs. In case of hemorrhage, the lower bowel should be emptied with a cool water enema; this alone will often stop a moderate hemorrhage. If it does not, then the patient can be placed on a tip-up table and, through the sigmoidoscope, the bowel can be further cleansed as necessary with water and the suction pathfinder, until the bleeding point is located. The open vessel should be grasped with a long alligator forceps and coagulated slightly. On top of this a pledget of cotton with adrenalin has, fortunately, in my limited experience, completed the hemostasis. A blood transfusion, which conceivably might in some cases be necessary, in all probability will favorably affect the hemostasis.

The question of sterilization of multiple polyposis cases arises. To be successful it would have to be applied to all children (male and female) of an afflicted parent, because of possible skip-transmission.

Where practically all the mucosa of the rectum and pelvic colon is covered with polyps, their fulguration would be such a tremendous task that complete colectomy with permanent ileostomy is preferable. The colectomy can be done in two or three stages as the experience of the surgeon deems safest for the patient.

Regarding irradiation as a method of treatment I am unable to add anything to my previous report.[5]

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BOOK REVIEWS

ENDOCRINOLOGY IN MODERN PRACTICE. By William Wolf, M.D. Second Edition. Philadelphia, 1939. W. B. Saunders Company. Price $10.00.

This large book of 1077 pages covers the field of endocrinology from every conceivable angle and brings the subject matter up to date. In every sense of the term it is a textbook, but one which is eminently readable. Any physician, whether general practitioner or specialist, can turn to it with profit.

The various glands and their diseases are covered in separate chapters. Other special chapters cover allied subjects, such as the menopause, pregnancy, menstruation, obesity and sterility. There is an elaborate discussion of laboratory procedures and their use in endocrine diagnoses, and a section on the application of endocrinology to non-endocrine disturbances.

This edition is far better illustrated than the first, but unfortunately still lacks a bibliography.

TEXTBOOK OF GENERAL SURGERY. By Warren H. Coleman, M.D. and Robert Elman, M.D. Second Edition. New York, 1939. D. Appleton-Century Company. Price $8.00.

This work first appeared in 1936, but the authors have felt a new edition desirable to record more recent progress. The authors have remained of the opinion that the book should include only what they considered the most important details of general surgery "in such a way as to be of every day value to the practicing physician as well as to the medical student." In the new edition, obsolete or relatively unimportant material has been deleted or shortened. More important data, such as a consideration of sulfanilamide therapy, the prevention and treatment of bleeding in jaundice by vitamin K, mixed tumors of the lung, changes elucidating further the decompression therapy of intestinal obstruction (to name but a few) have been included in this volume.

Discussion of operative technique has been confined to a few of the more common types of operations, for the writers feel that "the fund of surgical knowledge is becoming too vast to include surgical diagnosis and detailed operative data in one volume. (For) an inadequate and brief description of an operation might lead to the erroneous conclusion that certain procedures were simple and might be performed with inadequate preparation on the part of the surgeon." This statement alone would influence us to favor this book. The volume is 1031 pages long, has 559 figures, a bibliography at the end of each chapter, and an index.

LA DERMATOLOGIE EN CLIENTÈLE. By H. GOUGEROT, M.D. Sixth Edition. Paris, 1939. Maloine. Price 220 francs.

Gougerot, one of the great names in dermatology, has brought up to date in a sixth edition his book on the practice of dermatology. This forms part of a series on medical practice, in which different authors have written texts on the application of their specialties to the needs of average practitioners.

Dr. Gougerot, who is Professor of Dermatology and Syphilology at the Paris Faculty of Medicine, is a recognized authority on the subject. He has attempted in this volume to differentiate the known from the unknown, to simplify and present only the essentials of the subject. The book is 800 pages long and intensely practical in viewpoint throughout. It is well illustrated by over 300 photographs, many in color.

Like most French books, it is inadequately indexed, but an attempt has been made through an exhaustive table of contents, to indicate where various items may be located.

TEXTBOOK OF PATHOLOGY. By Charles W. Duval, M.D. and Herbert J. Schattenberg, M.D. New York, 1939. D. Appleton-Century Company. Price $8.50.

The authors have written a book that stresses the relationship between pathologic physiology and altered tissue changes or morbid anatomy. They claim that "this permits of a better understanding of important clinical phenomena and their correlation with basic pathological

findings." The writers claim that pathology is a basic science, and that the student should be thoroughly grounded in histopathology before undertaking the study of disease from the clinical standpoint. With this the reviewer heartily agrees.

The subject matter is presented in such a manner that the theme of the text is the pathology of the living patient. This book has not been written along the lines of a "dead-house" subject. References from foreign literature have been purposely omitted and only those by English and American authors that are pertinent to the text are included. The subject is covered thoroughly and in detail. The reading is clear and easy.

In the 681 pages there are nearly 350 illustrations, many in color. The index is ample. All in all—everything to be desired in a text-book of this character.

Cancer Laringeo: su Tratamiento Quirurgico. By Ricardo H. Bisi, M.D. Buenos Aires, 1938.

This monograph on the surgical treatment of cancer of the larynx is very impressive in scope and wealth of detail. The detailed illustrations are very clear and instructive. It deals thoroughly with the indications for operative and non-operative intervention of laryngeal cancer. Many useful points are given as to the pre- and postoperative care in laryngectomy.

The Science and Art of Joint Manipulation. By James Mennell, M.D. Vol. 1,—The Extremities. Philadelphia, 1939. P. Blakiston's Son & Co. Price $4.50.

This book (233 pages) is different. It reveals in every chapter that the author is not writing a treatise on theory but a monograph on a subject with which he has had practical clinical experience. It is recommended to anyone who treats patients suffering from disorders of the joints of the extremities. The book sets a standard for teaching and practice in the science and art of joint manipulation and offers a standardized procedure for the technique of examination, diagnosis and treatment. The contents include a survey of joint lesions, referred pain, rules for manipulation, and studies of each joint by itself.

There are 284 illustrations and an ample index.

Cirurgia do Megaesofago. By Edmundo Vasconcelos and Gabriel Botelho. Sao Paulo, 1937. Companhia Editoria Nacional.

This monograph on the surgical management of the mega-esophagus, by Professor Vasconcelos and Dr. Botelho, of the Medical Faculty of the University of Sao Paulo, Brazil, is a thorough, up to date study on a very important surgical problem. It consists of 401 pages in Portuguese, covering the history, theories, physiology, histology, pathology, diagnosis and surgical procedures of this annoying esophageal malady or lesion.

Were it not for the linguistic problem, this book should be in every medical man's library. Nevertheless, thoracic surgeons would do well to familiarize themselves with this important monograph.

The Endocrine Glands. By Max A. Goldzieher, M.D. New York, 1939. D. Appleton-Century Company. Price $10.00.

Endocrinology is one of the foremost topics of medicine of the present era. Hardly a week passes but new discoveries in this field are made or new theories offered for consideration. It has become a complex, involved part of medicine, which calls for an understanding of some of the basic sciences and an appreciation of clinical realities. Therefore, this book by one who has devoted his energies to this field for over thirty years is welcomed.

The writer has utilized the recent advances in the field of physiology and pathology for practical purposes in the diagnosis and treatment of endocrine disorders, and offers simultaneously evidence to support the statements made. The book can serve as a source of references for those who desire additional detailed information.

In addition to stressing the morphology, physiology and morbid anatomy, the author presents a new and detailed classification of the endocrinopathies, and, in addition, discusses the prevalent methods of diagnosis and treatment.

This work contains 916 pages, with references following each topic. There are 271 figures and an index.